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THE RAILWAYS OF CHINA, EXISTING AND PROSPECTIVE.

By Andrei Kmita.

[Peking, January 31, 1898.]

The existing railways of China, compared with those projected, are as the good things done to those left undone. The railways in operation extend from Tientsin to Tong-Ku, the actual seaport, and from Tong-Ku to Shan-Hai-Kwan, where it passes through the "great wall" and north 30 miles into Mongolia. The length is 210 miles. This line has been in operation for a number of years, and if the Chinese Directors would allow the foreign employees to manage it, would be a well paying line. Northwest from Tientsin is the railway to Peking 80 miles in length. This line has been in operation seven months, and as yet it has but a single track. The traffic, both in freight and passengers, is so great that, despite Chinese Directors, this line is to-day one of the best paying railways in the world. From the junction near Peking the first section of the Peking-Hankow Railway is about completed to Paoting. There is a short railway of 12 miles from Shanghai to Wu-Sung nearly completed. The work on this line commenced about the same time as the work on the Tientsin-Peking line, but as yet no trains are running.

This completes the list of existing railways. With the exception of the Wu-Sung line they are all Imperial Chinese railways, and are practically owned and operated by the Imperial Government. They have all been built under the direction of English engineers and the design and manner of execution of the work is most excellent. The Chief Engineer, Mr. C. W. Kinder, has been in Chinese employ some fifteen years and his work shows a careful study of the special conditions that obtain here and the best methods of satisfying them. The rolling stock is of the American type, the locomotives for the Tientsin-Peking line and the Peking-Paoting line are all American. This entire line is upon the flat alluvial plain and any engineering difficulties encountered are in the construction of flood opens and not in the location of the line. The entire design of the road and equipment is a combination of American and English practice that appears best suited to this country. The Wu-Sung line is under German engineers, but the locomotives contracted for are American.

In regard to the prospective railways of China, we will commence at the north with the continuation of the Russian Trans-Siberian Railway across Chinese territory to Vladivostok. The Chinese granted permission for the construction of this line in a secret treaty, arranged and signed in Peking by the Russian Minister, Count Cassini. The alleged reason of the Russian desire was a more direct route to Vladivostok. The distance saved is about 200 miles, but the country passed over is exceedingly rough in parts and the cost of construction will be great. Manchuria is exceedingly rich in all food stuffs for men and cattle. Russia must have these to support her Siberian population and army, and a railway through the heart of the province gives her absolute control. This line bears the title of "The Chinese Eastern Railway Company." It is ostensibly a Chinese railway, but located and constructed under Russian engineers, paid for by Russian money and when finished will be entirely under Russian control. This road is financed by the Russo-Chinese Bank, with headquarters at Peking and branches at many of the open ports. The capital of this bank is entirely European and not one share is owned by a Chinaman. The Russians have the right to station their troops in Kirin and at every town along the proposed railway. All of the engineers have Cossack guards and Russia is allowed to protect her subjects in this part of China with her own soldiers and without regard to Chinese officials. The attitude of Chinese officialdom to Russia is disgustingly abject. The directors, superintendents, engineers, bank managers, clerks and soldiers are all Russian. The office boys, house coolies and servants are Chinese. Such is a Russo-Chinese combination. The Chinese people welcome the change. Any master is better than the mandarin.

None of this line is as yet constructed and but a slight portion finally located. Engineers, however, are at work on every section and a few years will see it completed. Russian engineers are locating the railway from Kirin through Murkden and Neuchwang to Port Arthur. The Russians now occupy Port Arthur and are preparing to rebuild it for the Chinese. It will be rebuilt with Russian money, under Russian engineers, and in accordance with Russian designs. Russia will then undoubtedly guard it for the Chinese.

It may be of interest to know that the Russian troops in Siberia are so stationed, that by two weeks' easy marches, over one hundred thousand can be concentrated at Kirin. This will become necessary for the protection of China if her autonomy is threatened by a foreign power. Autonomy may here be defined as the right of China to govern herself in accordance with Russian specifications.

The Imperial Chinese railways will be continued north to some point beyond Kin-Chou, where a connection with the Russian system will be made. Some change will then be necessary, as the Chinese system is 4 feet 8½ inches in gauge, while the Russian system is 5 feet.

A projected line upon which some preliminary work has been done extends from Peking through Kalgan and Kiakhta to Verkhneudinsk on the Trans-Siberian Railway. This line follows, more or less, the present caravan route, over which, each year, hundreds of thousands of camels transport tea to Siberia and return with wool, camel's hair and furs. The traffic over this line would be important, and unless a check is put upon Russian influence there will be another Russo-Chinese combination railway company.

The Peking-Hankow-Canton Railway will be the great trunk line of China. Nearly every syndicate that has been represented in China during the last fifteen years has made an effort to secure this line. A New York syndicate had a representative here for over two years working for the north half of this railway, Peking to Hankow. No agreement was possible between the Chinese and the syndicate and the representative was withdrawn. The methods of negotiation used, while possibly correct in the United States, were not at all so when dealing with the Chinese in China, and until Americans make

penses. One of the most important concessions is for the Tientsin-Shanghai line running through the Province of Shantung and down the coast. This is being negotiated for by a Chinaman who has lived many years in the United States and he is promised financial aid by a New York syndicate that now has an agent on the way to China. In view of the preliminary requirements demanded by previous American syndicates it is doubtful whether any final arrangement will be possible.

The Shanghai-Nanking-Hankow line, following more or less the course of the Yangtze River, and the direct Shanghai line, are both asked for by various parties. Both lines run through an immensely rich agricultural country swarming with people. But either line must divide the traffic with the river steamers. The short line from Shanghai through Hang-Chau to Ningpo probably has more people to the mile than any proposed railway in China. The population along this line runs up to several millions. The coast line from Shanghai to Canton runs through the rich tea and rice country. Another Canton line comes down the center of Kiangsi with its millions of people. Southwest from Canton is a proposed line in the direction of Tongking. This completes the proposed railway system of Eastern China.

With the exception of the Russo-Chinese line the right of construction of none of the proposed railways has been granted to a foreign syndicate. The financially sound companies in the field are few, and all of this work must be paid for with foreign capital. No Chinaman will subscribe one cent as long as the management is in the hands of the mandarins, and yet China must have these railways soon in order to increase her revenues, and there is not one of these proposed lines but what would prove a good investment.

Returning to the north of China. The Germans will at once build a railway across the Province of Shantung from their new port of Kyao-Chou to some point on the Grand Canal. This is not the result of an agreement between the Chinese Railway Administration and a foreign syndicate, but the result of a German-Chinese combination in which Germany holds all of the votes.

The only concession to a foreign syndicate that has been signed and ratified, and upon which actual work has been done, is the "concession in perpetuity" of all rights for working the coal and iron deposits in the Province of Shansi and the right to construct and operate all railways necessary for placing the products of these mines on the market. The Province of Shansi has an area of 90,000 square miles. It is surrounded on all sides by mountains and has an interior plateau some 3,000 feet above the sea. The coal deposits in this province exceed in extent, quality and continuity any fields the civilized world has yet seen. Baron von Richthofen, the greatest authority upon the geology of China, gives the area of unbroken coal strata in Shansi at about fourteen thousand square miles. The writer of this has examined an area of over 200 miles long and 30 miles wide. Over this entire area the continuity of the coal strata was unbroken and at any point there is workable coal of over 30 feet in thickness. This statement is not made from a mere examination of surface indications, but from examinations of hundreds of native mines.

In two sections at least in this coal area, Ping-ting to Yu and Tse-chou to Su-an, there is associated with this coal deposit a wonderfully pure iron ore, brown hematite and spathic. A railway will be built from each of these iron centers to the alluvial plain of Chili. Both of the lines terminate not only upon the Peking-Hankow Railway, but upon water-ways navigable to the sea by the way of Tientsin. Considering the great scarcity of coal in China and the poor quality of the Japanese coal, the opening of these mines will certainly create something of a revolution in the coal markets of the world. The small native iron furnaces turn out each year some tens of thousands of tons of manufactured iron, and what an immense effect upon trade modern methods on a large scale will have can be imagined. The preliminary surveys have been made and at present an American mining engineer is in the

field to locate the works. The actual work will begin in April. This concession of mines and railways will be more far-reaching in its effects upon the world's industrial economies than any other concession asked for.

Turning to the Southwest of China and the Province of Yunnan, we see some proposed lines of what we may call political railways. Yunnan is said to be very rich in all mineral deposits. It is a province little known and exceedingly rough and mountainous. One the west is British Burma, on the south French Tongking. Both England and France wish to run through Yunnan to Yunnan City and thence north to some point on the navigable waters of the Yangtse. These desires cause much diplomatic wire pulling in Peking. The French claim that their convention is signed, the Chinese deny it; England makes the concession of these Yunnan railways one of the conditions upon which she will lend China sixteen million pounds. Russia insists that China must use only Russian money, etc. What are the actual facts in the case "is one of those things that no fellow can find out, for when two or three are gathered together in the name of diplomacy there the Devil is in the midst of them."

China is going to be opened to the world—not from any desire on the part of China, but from sheer necessity. China must have foreign capital to enable her to remain intact. To procure this capital she must exploit her resources. She must submit to the inevitable and open her country to foreign enterprise and methods, or the surgical operation of dismemberment will be performed.

THE CONSTRUCTION OF A MODERN LOCOMOTIVE.*

III.

By Motive Power.

Schedule of Work.—For the purpose of facilitating output and economy of time, it is essential that not only the capacity of each particular department, but the order in which material will be required in each one of the departments, shall be known, and it is understood that all of the departments outside of the erecting are contributive in finished or partly finished material used in final erection.

Experience has shown that the arrangement of gangs and divisions of work in the erecting shop, also the relative time required for the erection of work included in certain sub-divisions in this shop, can be taken as a guide or schedule for the furnishing of the various parts required in this erection, and this schedule used as a guide by other departments, informing them of the order in which the various parts specified on it should be gotten out and delivered to the erecting shop. The same schedule is given to all departments, for the reason that some, if not all of the parts included on it have work done on them in the various departments. This schedule is not intended to cover all of the parts in detail required for the complete locomotive, but rather to give a fairly accurate and general idea of them, and their various groupings, conforming to the division of the work in the erecting shop on the lines above mentioned. For instance: The frame work is done entirely by one or more gangs, and may include any convenient groupings of parts. Considering it to include all of the work on the frames necessary to make ready for the mounting of the boiler, and equipped with cylinders, guide yoke, rocker boxes, rockers, lift shaft and bearing, stiffening pieces, pedestal caps, foot plates, cross braces, front and back end castings, etc., the schedule will mention these various parts, which will be grouped, by means of brackets, into sub-divisions, and each one of these sub-divisions designated by numbers intended to indicate the order in which they shall be required by or delivered to the erecting shop.

The grand divisions of the detail schedule of parts required for the engines may be designated by capital letters, and need

* For previous article see page 116.

not comprise more than six or seven such divisions. For instance: Frame work may be known by the letter "A" and contain in its grouping the cylinders, rockers, etc., as above instanced; "B" may be understood to indicate the boiler, with all of its mountings prepared for mounting on the frames; "C" the general erection, and including such parts as will be required in the general erection; "D" air brake and driver brake work; "E" tank work, and so on. In fact, these divisions can be made to suit the peculiar requirements of the plant or the individual taste of the management, the main object being to provide a universal schedule for the governing of all departments contributing parts to the erecting shop, and in such a way that these parts will be gotten out in their required order, without unnecessary confusion and delay, also controlling the movement of the work through the various departments on time and in time for the economical and prompt completion of that order of engines.

It will also be obvious that these schedules may be used as a guide in the specification as to the time of delivery of raw material, and will prevent the unnecessary accumulation of such material to a larger extent in one month than would represent the consumption of the plant, avoiding excessive balances in stock accounts and unnecessary investment, also acting as a guide for the starting of a very large amount of work on the order for engines in various departments where certain kinds of stock material are carried, and enable a very large amount of work to be done systematically, and to great advantage, pending the arrival of material on order.

The very careful supervision of this or the more thorough adoption of a scheme of this kind, or some satisfactory modification of it, in plants where the equipment would apparently be below the requirements of output, will in many cases, without additional investment, bring about a larger output with the original installation, enabling departments which are apparently weak in facilities to start long enough before the time required for the delivery of material in producing their output to anticipate the largest demands made on them.

Testing.—There can be no question of the advantage of a systematic and thorough method for the proper testing of all the material used in the construction of a modern locomotive, and having this department located at the works where the construction is carried on. Not only does a department of this kind act as a check on the use of poor or defective material, but it facilitates the keeping of accurate records of kinds of material used in any particular form of construction, which, if properly kept, may be used as a reference and referred to as a history of not only the poorest, but the best material for construction of this class of machinery. The records of performance in actual service of this kind of material, where possible, should also be kept in this department.

Boiler Shop.

Generally speaking, and of course controlled, to some extent, by the capacity of these departments, the boiler and blacksmith shops will have to lead on the first work on an order for engines, and commence work on them before the other departments.

Higher steam pressures and more severe service, independent of designs, have had a very material effect on methods of boiler construction, and in no one part of the locomotive should more pains be taken, not only in the general, but detailed construction.

The general arrangement of facilities and the method of handling work in this shop should be such that the stages of progress from raw material to the finished boiler would be continuous and progressive from the point of delivery of raw material at one end of the shop to the completion and exit of the finished boiler at the opposite end. Retrograde movement in the handling of work should by all means be avoided, and special attention should be given to appliances which will reduce the actual cost of labor of handling.

In a general way, the work in this shop may be divided into

the following divisions: The laying off and templet work; punching, shearing and planing; flanging; fitting up and riveting; and flue work.

Depending, of course, upon conditions, size of plant, etc., the boiler work may include all of the tank work, pipe and sheet iron work, as well as coppersmith work, and it is convenient, with an arrangement of this kind, to have it all under the direct charge of one foreman, with such gang foremen in charge of convenient sub-divisions as may be necessary. The work of laying off should be done by a man capable in every way, and well able to read and interpret drawings, whose work will act as a very valuable check against any errors which may be made in the drawings.

The question of drilled or punched holes and holes punched before and after sheets are bent, has been discussed fully from time to time, and each of these methods has both good and bad points. The recent construction of machinery adapted to the drilling of holes after the sheets are bent will no doubt in many cases be preferred as giving better results, especially on very heavy sheets, than where the holes are punched smaller than required when the sheets are flat, and reamed to size after the sheets are bent. We have, however, seen very excellent results on high pressure boilers by this latter method, and do not think there is any serious question of the strength of the bridging between the holes where the punched holes are small enough to allow a margin for the reaming out of the distressed material around the edges of the holes. The fin left on punched holes, especially where the sheets are to be bent and the fin side of the hole would come on the outside of the curve, should by all means be removed. We have known of cases where the sheets have cracked in the bridging, due to this cause alone, the thin edge of the fin presenting a hard, sharp surface which is readily fractured with the stretching of the outside of the sheet, due to bending; and have also known cases where fire box side sheets of perfectly satisfactory material have been condemned as poor material; whereas, the real cause for the cracking was due to the fins referred to, and tests made with the fins removed on the same kind of material did not in any way show the slightest sign of fracture.

The edges of all sheets which are to be calked after being in place, wherever possible, should be planed at a sufficient angle with the flat surface of the sheet to give a satisfactory amount of metal for tucking up without the danger of springing the sheet away from its mate.

Flanging.

Where properly and intelligently handled, there is no question of the advantage of machine over hand flanging. The press for this purpose should be of at least 300 tons capacity, and in addition to the main ram for raising the table, should be provided with a center ram telescoping in this main ram, four auxiliary or jack rams, and also a ram working from the top platen downward. It will also be found convenient to have portable side cylinders, which can be bolted on the lower table for side clamping on such work as the flanging of certain kinds of throat or connecting sheets.

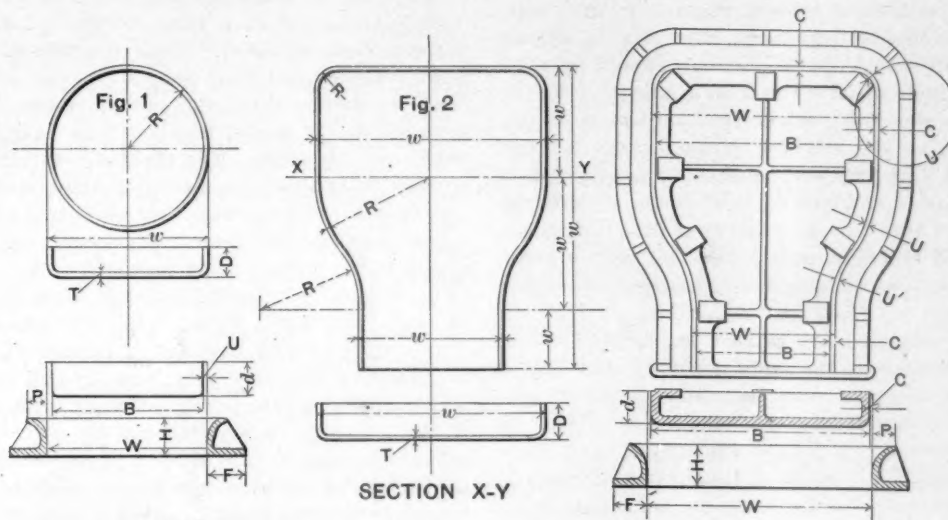
The substitution of machine flanging, in one or two operations, with full size dies, in this country, at least, is comparatively new, only having been more or less commonly adopted within the last few years. At the time of the writer's first experience with this character of work there were probably not more than two machines of the particular type with which he had to do in this country, and the information, data, etc., in connection with the designing of the dies, their use and proper allowances to be made, was decidedly meagre. A careful research failed to discover in any of the known publications information which could be used as a guide, and as the result of a great number of experiments, covering a period of several years, we give for the benefit of those who may be seeking information of this kind, a set of formulae, which are generally applicable to this class of work, being particularly connected with flanging, i. e., where the metal is turned up around a former. We make this distinction as between metal

formed in this way and that drawn through a ring, which is commonly known as "drawn" work. This formula has been repeatedly tested in the practical designing of dies for a wide range of work and found perfectly satisfactory.

In cases of doubt connected with the forming or flanging of difficult sheets, a small set of dies, made to a scale size, of hard wood, and used to flange a piece of sheet lead, of also a proportionate scale thickness to the full size sheet, has been found very satisfactory, and owing to the fact that annealed sheet lead, in its action, is analogous to a sheet of boiler steel of full size heated to 1,700 to 1,900 deg. F., the action of the

and rather slow heat. The method of delivery of the heat to the bed of the furnace, in which the sheet is placed, should be such that no one portion of a sheet can become overheated by reason of flame contact. In color the heat should be not exceeding a bright cherry, and in temperature it may range from 1,700 to 1,900 deg. F., according to the character of the flanging.

Before flanging the first sheet, the dies should be heated up, so that their proper expansion, which is provided for in the formula referred to above, may take place, and the sheets, when cool will be of the proper size. A common method of



Values of letters used in formulæ:
 w = Size of flanged sheet or any portion of it when cold.
 R = Radius to outside of flange when cold.
 D = Depth of flange when cold.
 T = Thickness of sheet when cold.
 W = Size of female die when cold.
 B = Size of male die when cold.
 C = Clearance between male and female dies when straight and when cold.
 U = Clearance when curved and edge upset.
 U' = Same when stretched.
 S = .0078" per inch allowance for contraction of sheet.
 All dimensions in inches or decimals of an inch.
 For general proportions of male and female dies:
 $H = 2.1 D$; $F = 2.1 D$; $P = 1.2 D$ and $d = 1.5 D$.

Note.—For ordinary practice and for radii not less than 3" or more than 15" and when "D" does not exceed 4"—"U" can = $1.27T$. The female die decides size of sheet and all allowance for clearance must be made on male die.

Then for Fig. 1:

$$W = wS + w \text{ and}$$

$$B = W - \left(\frac{D}{J} \times .1298 \right) + 2.4T = W - 2U.$$

$$U = \left(\frac{D}{T} \times .0649 \right) + 1.2T.$$

$$U' = 1.2T - \left(\frac{D}{T} \times .0649 \right)$$

For Fig. 2: $W = wS + w$ and

$$B = W - (1.2T \times 2).$$

$$C = 1.2T.$$

Formulæ for Dies for Flanging Sheet Steel.

lead in these dies can be taken as a guide indicating the action of the full size sheet in regularly designed dies for a similar shape. The stretching or upsetting action of the piece of lead used as an illustration in these small dies can be very readily noted if the sheets when flat, and before being formed are laid off in small squares of some convenient size. The distortion of these squares after the flanging of the model sheet will graphically indicate the distortion of the metal, and will be analogous to what will occur in the full size sheet in regularly designed dies.

The flanging press should be located in front of the furnace, with a sufficient space between it and the furnace to allow of a generous sized iron straightening floor. Convenient lifting facilities should be provided for handling the dies, and also, in the case of heavy sheets, an overhead rail or some satisfactory form of quick moving crane for handling the sheets from the furnace to the press, it being important to place the sheet in the dies as quickly as possible after it leaves the furnace, for the best results.

The furnace should be provided with a level, flat floor, preferably of fire brick, and may be heated by either coal, burned in a separate regenerative chamber, producer gas or oil. The construction should be such as to provide an evenly distributed

doing this is to heat the first sheet and place it on the dies without flanging until the dies become sufficiently hot. Between the operations of flanging the dies should be thoroughly wiped on their friction surfaces with some heavy oil, with a hand mop.

The operating levers and the operator for operating the press should be as close to the press as possible, so that the various stages of the operation of the die in performing the work may be closely observed. A center mark placed on the sheets, and corresponding center marks on the dies, will greatly facilitate the centering of the hot sheet on the dies and save time. The larger sheets, after being flanged, will be found more or less out of true on their flat surfaces and will require straightening. The iron straightening floor referred to is provided for this purpose, and this work can be done with the remaining heat in the sheet after flanging.

All flanged sheets should be thoroughly and carefully annealed after they are finished and before being placed in the boiler. Flanging by power being practically one operation, will undoubtedly introduce into the sheet less local strains than would be the case with hand flanging, and such as it may produce are effectively removed by the careful annealing suggested.

Dies for Machine Flanging.

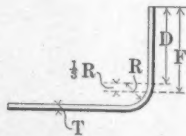
The accumulation of dies for this character of work, unless they are carefully designed, with a view of preventing unnecessary duplication, becomes a serious matter, as they occupy considerable space and represent a large investment.

Figures 12 to 17, inclusive illustrate a convenient way of making some of the more intricate forms of these dies in sections, permitting the introduction of liners for change of dimensions, and new pieces of irregular shape where the outside shape is changed. These are also intended to illustrate a convenient record of the dies themselves, which the writer has had in operation for several years, and found perfectly satisfactory. Each one of the diagrams is intended to show only the castings used for that particular die and class of engine. In each case where this same die would be used for another class of engine another diagram is provided. These diagrams should bear all of the information which would be vital as a matter of record of the dies, and they should be accompanied by tables of the parts, numbered, and by the use of a gauge on the flanging press blank spaces, giving pressure required to raise the dies and table per square inch, and also to do the work of flanging, may be filled in. This will become a source of data in connection with the question of power required for this kind of work and a means of comparison in questions of flanging new work not as yet tried.

These dies may be designed so as to reduce the amount of machine work in their construction to a minimum, and this is specially true where they are made sectional, it being only necessary to have them cast of the proper shape and as smooth as possible. A file finish on the friction surfaces in most cases will be found sufficient, and while it undoubtedly absorbs somewhat more of the power of the machine, the saving is so great compared with this advantage that the method becomes an economical one.

The speed with which the dies are brought together has a very important bearing upon the success of the work, and in some cases it will be found that better work can be done, as regards the tucking up of corners; where a large amount of metal is to be upset, by changing the speed of the table, or opening the operating valve only partially, as may be determined by experience. We have known cases where dies thought to be defective have proven perfectly satisfactory by merely changing the speed of travel of the table.

The following formula will be found of assistance in determining the greatest depth of flange permissible for good, average work:



$$F=D+1-3 R=14 \text{ times } T \text{ or thickness of sheet.}$$

It is true that in some cases greater depths than this can be flanged, but its continuance cannot be relied upon. Generally speaking, unless the radius is excessively large, the depth of flange which may be successfully made without excessive buckling will not exceed 14 times the thickness of the sheet. Where it is desired to secure a greater depth of flange than this, it may be secured by drawing instead of flanging, the ordinary form of dies consisting of an upper ring, which is practically a female die, a lower or clamping ring and a male die, which in its shape conforms to the inside shape of the sheet to be produced. In the case of thin material, unless extra care is taken to work the sheet very quickly, considerable difficulty will be experienced in removing the sheet from the male die after it has been drawn in this way. This is especially true where no taper has been allowed in the male die, and which in some work is objectionable. A convenient way of getting over this difficulty is to leave sufficient stock on the blank so that, when it is formed up to the proper depth of

flange, there will still be a small amount, either remaining in, or only partly removed from the female die, making the holding-up ring of such a size that this excess material will present a larger diameter than the outside diameter of the finished piece, and will in this way act as a stripper on the male die. The excess material is so very slight that its loss as scrap is a trifle compared with the lost time and annoyance of reheating the sheet after it has shrunk on the die.

Interchangeability and Templets.

With comparatively few exceptions, templets for location of punched holes may be omitted where satisfactory spacing punches are provided. A complete system, however, of templets should be prepared, with the view of securing absolute interchangeability in a large number of duplicate parts for the same type of boiler. These templets may either be made from a special material, ordered for the purpose, or in some cases, where this expense is not warranted, they may be made from one set of sheets, which will be finally used for the last boiler on that order. The checking of these templets should be done by at least two men thoroughly conversant with their use, to prevent any possibility of error. With properly prepared templets and careful supervision of detail, all of the sheets in the boiler, when delivered to the fitting up department, should be interchangeable. A practical demonstration of this, covering a period of several years, has more than proved to the writer that, following modern methods, there is no necessity whatever of putting up and marking off sheets, which is still a frequent practice in some boiler shops. All of this excessive rehandling can be avoided by the templets referred to. In the case of holes in connecting or throat sheets for barrel and fire box connections, these throat sheets may be placed on a surface plate, properly leveled and lined up, and the holes laid off, both for the barrel connection and the fire box connection on parallel planes. As the holes in the fire box and the barrel have been previously accurately punched to templet, there is no reason why this hip or connecting sheet, having been flanged in dies which produce them all in duplicate, should not be interchangeable on all boilers of the same type, and when once placed in position remain there.

The use of heavy sledges in connection with the fitting up should by all means be prohibited, as the high grade of material used in present boiler construction does not admit of punishment of this kind, and in thick sheets the vibrations set up by repeated blows of a heavy sledge are very apt to crack portions of them, especially through the holes.

Sheets that have not been properly formed should be reformed after being heated, and no attempt should be made to do either this work or scarfing cold. Not only does the heat in the case of fire box sheets have considerable to do with the efficiency of the scarfing, but the location of the anvil at which the scarfing is done. We have known of one or two cases where fire box material of excellent quality has been condemned as being too brittle when the only reason why it failed or cracked in the scarfing was because the anvil on which the scarfing was being done was located too near a door; it being in the winter-time, the cold draught across that portion of the sheet allowed it to cool too quickly and gave opportunity for cracking.

Tack bolts should be placed in at least every other hole on the more important sheets when they are fitted up and tightly drawn. All barrel sheets and side sheets should fit sufficiently close, without straining seriously, to permit of a flat gauge, 0.015 of an inch in thickness to go no further than the center line of the first row of holes.

On the mud ring, in addition to the inside and outside the front and back surfaces of the bottom should be finished, and the templet used for laying off the holes in the side sheets should have points of contact with these bottom surfaces. As the side sheets themselves are laid off with reference to a center line, it will be obvious that when the mud ring is in place these finished places will answer as datum points to work from

in lining up the barrel. The same thing is true with reference to the front end extension and its rings, and the result will be that when the boiler is connected up the center lines will coincide, and the center line of the boiler will bear a definite relation to the surfaces of the mud ring and will be similar on all boilers of the same design. The absolute accuracy of this method of lining up permits of the chipping of the cylinder saddles to a templet without incurring the lost time usual in placing the boiler on the frames, marking off and blocking up. This will be explained further in connection with the use of templates in the erecting shop.

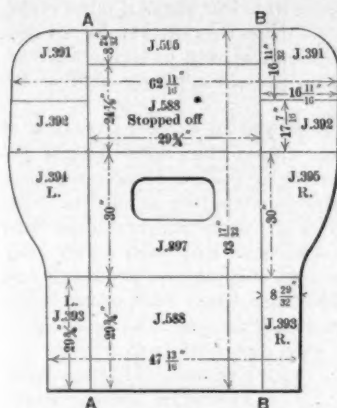


Fig. 12.—Male Die, Back Head.

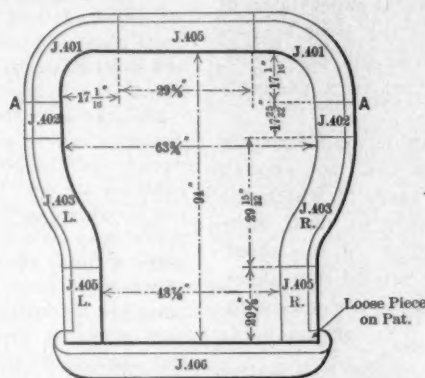


Fig. 13.—Female Die, Back Head.

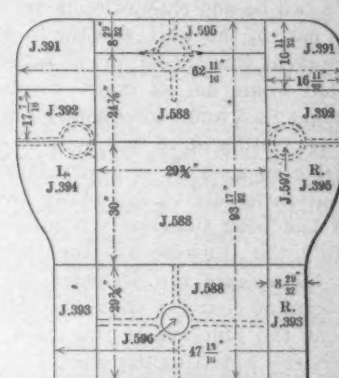


Fig. 14.—Holder Plate.

Gauge and surface cock holes and various other holes for connections on the back head are provided in the templet and punched in the sheet in the boiler shop; also certain holes for cylinder saddles in the front end.

Riveting.

Where possible the contact surfaces of riveted joints before riveting should be thoroughly acid-washed to remove any excess scale. After the sheets are thoroughly bolted up and rigidly held in place, the intermediate holes may be reamed to the proper size and the bolts in the other holes inserted suc-

toughness; whereas the distortion and twisting of the grain of the iron rivet in driving seems to weaken instead of strengthen it.

The heating of the rivets should be done in such a way as to give the minimum amount of scale, and every precaution should be taken to free them from scale before being driven. The interposition of this scale between the rivet and the surface of the hole and the head of the rivet and the surface of the sheet is frequently the cause of leakage and loose rivets.

All riveting, as well as the character of fitting up, fitting up

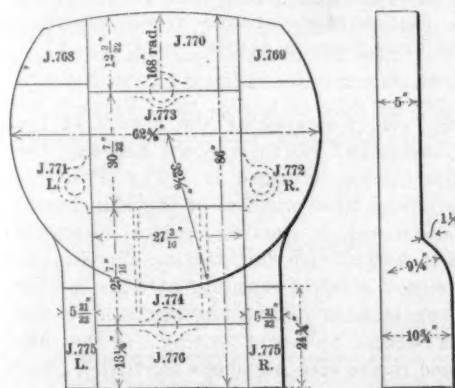


Fig. 15.—Back Tube Sheet Holder Plate.

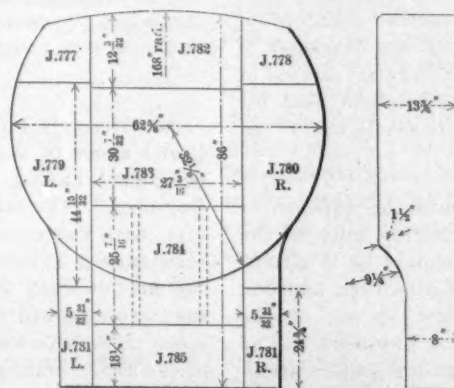


Fig. 16.—Back Tube Sheet, Male.

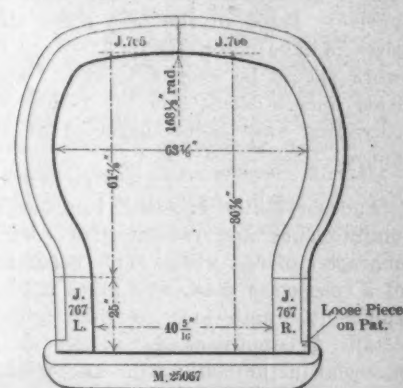


Fig. 17.—Female Die.

cessively in the reamed holes and drawn up tight; the balance of the holes may then be reamed and the work riveted before the bolts are removed. All of the holes should have the small fin due to reaming slightly removed; in fact, be very slightly countersunk; this should not exceed 1-32 inch.

Great care should be used in not only the heating, but the driving of rivets, and a form of head used which will permit of prompt upsetting of the shank of the rivet in the full size of the hole, also providing the minimum amount of extension on the plate consistent with the maximum amount of vertical strength through the head. In a properly designed head of this kind the set will be of such shape that the end of the rivet on which the head is formed will promptly center itself, and there will be little danger of heads driving out of center.

We do not consider, as a general thing, that the use of steel

braces, which is included in the fitting up, should be subject to frequent and very careful inspection, and we wish to emphasize that it is only by the most rigid inspection of the smallest details in the construction of the present type of high pressure boilers that the best work can be secured.

Stay Bolts.

While it is true that design, quality of material and general treatment in service are many times largely responsible for the excessive breaking of stay bolts, we believe that, in a great many cases, the blame is placed on these causes when in reality the methods and the non-observance of the little things of importance in putting in stay bolts deserves full credit as the principal cause.

The variation of lead in taps and between outside and inside side sheets is responsible for a great deal of discussion on

these lines. When it is borne in mind that the greatest variation, without counting an additional thread, cannot exceed 1-24 of an inch, it will be obvious that not only must the side sheets be absolutely right, but remain in that position against the action of the tap, which, while tapping the outside side sheet, is frequently starting the first threads on the inside side sheet, with all of the severe resistance of a feed of 1-12 of an inch, and we have seen cases in which, following the tapping of each hole, the stay bolts themselves were inserted and a straight-edge, placed on the inside side sheet before and after the row of bolts has been inserted, indicated a variation of at least $\frac{1}{4}$ -inch out of a straight line. This can be and should be prevented by careful supervision of this part of the work and the insertion of either cross spacers to prevent this thrust, or, at satisfactory intervals, stay bolts, which would act as stays, keeping the sheet in a perfectly straight line, and consequently normal.

The riveting up of stay bolts after insertion is too frequently considered such an ordinary form of labor that not enough attention is paid to it, and we have noted cases in which the bolt had been sufficiently hammered, not only to upset thoroughly the threads into the threaded portion of the sheet, but to increase the diameter of the bolt beyond the sheet. We cannot conceive that this bolt would have the maximum life at the juncture of the sheet and the bolt, or the point where this upsetting takes place.

The common method of holding up on these bolts while being riveted does not permit of a perfectly uniform resistance against the end of the bolt on the inside of the fire box. The space being somewhat contracted, there are only a few points in which a man can assume a position of greatest purchase on the lever bar. The result is that at these points the bolts are riveted up with one resistance, and at other points with a different resistance. The disadvantages of this will also be obvious. A very simple and efficient form of pneumatic holding up arrangement has been introduced for this purpose, and to a very large extent will overcome the factor of unequal resistance while hammering up. It is our opinion, however, that these bolts get entirely too much hammering up, and a great deal more than what is required if they were properly fitted in the first place and a correct standard of sizes of taps maintained. The taps used in this character of work should be subject to check when in regular service at least once a week, and the results of the machine used for threading stay bolts inspected at least once in every ten hours.

Flue Work.

Another factor entering very largely into the expense of maintenance and reduction of cost per engine mile is the character of flue work. This department should be in charge of a competent man, who gives it his sole attention, and one sufficiently ambitious to thoroughly follow up all of the detail. It is not necessary to safe-end flues in new work. The material in the body of the flue, if sufficient for proper length of service, should be good enough to take the place of a safe end.

All of the tools used in this department should be of such a kind as will give the least possible variation in sizes, due to wear, in the preparation of the flues. For the swaging the use of hollow dies has been found decidedly advantageous over the ordinary and older methods of doing this work. These dies are very efficiently used in a machine operated by compressed air, and not only maintain their size, but give an absolutely uniform result in the work.

Particular attention should be given to the maintenance of a standard in the shop of the Prosser expanders used, and a frequent inspection of these will go a long way to prevent the introduction of defective work due to the usage of tools of this kind worn and unfit for service, but apparently in perfect condition, until standard gauges are tried on them.

The general use of pneumatic appliances for reaming, tap-

ping, beading, calking and doing a great variety of small work in connection with boiler construction, will prove very advantageous in the interest of economy.

(To be Continued.)

NEW RULES FOR CONSTRUCTING MARINE BOILERS.

According to a circular recently issued by the Treasury Department, Steamboat Inspection Service, all boilers built for marine purposes after July 1, 1898, shall be required to have all the rivet holes [in the shell] "fairly drilled" instead of punched, and the longitudinal laps of their cylindrical parts double riveted, to be entitled to 20 per cent. additional pressure. (Also that steel plates of one-half an inch thickness and over for all boilers shall have all the rivet holes in the shell "fairly drilled" instead of punched.)

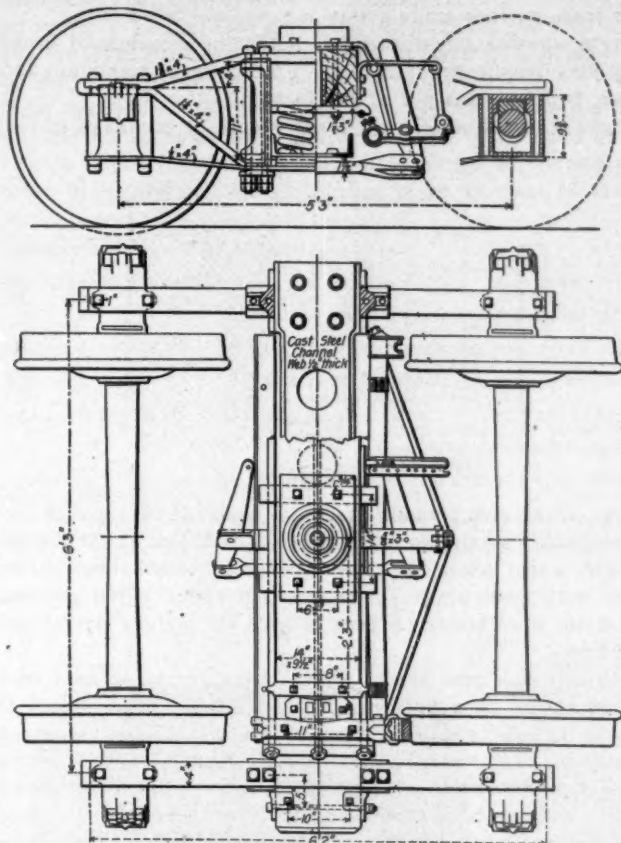
No braces or stays hereafter employed in the construction of boilers shall be allowed a greater strain than 6,000 pounds per square inch of section, and no solid or hollow screw stay bolt shall be allowed to be used in the construction of marine boilers in which salt water is used to generate steam unless said screw stay bolt is protected by a socket. But such screw stay bolts without socket may be used in staying the fireboxes and furnaces of such boilers and elsewhere when such screw stay bolts are drilled at each end with a hole not less than one-eighth inch diameter to a depth of at least one-half inch beyond inside surface of sheet, when fresh water is used for generating steam in said boilers (to take effect on and after July 1, on all boilers contracted for or construction commenced on or after that date). Water used from a surface condenser shall be deemed fresh water. The flat surface at back connection or back end of boilers may be stayed by the use of a tube, the ends of which being expanded in holes in each sheet beaded and further secured by a bolt passing through the tube and secured by a nut. An allowance of steam shall be given from the outside diameter of pipe.

For instance, if the pipe used be $1\frac{1}{2}$ inches diameter, outside, with a $1\frac{1}{2}$ -inch bolt through it, the allowance will be the same as if a $1\frac{1}{2}$ -inch bolt were used in lieu of the pipe and bolt. And no brace or stay bolt used in a marine boiler will be allowed to be placed more than $10\frac{1}{2}$ inches from center to center to brace flat surfaces or fireboxes, furnaces and back connections; nor on these than a greater distance than will be determined by the Board's formulas. Flat surface on heads of boilers may be stiffened with doubling plate, tees, or angles.

Electricity is largely used for working the cranes at the Crewe shops of the London and North-Western Railway, the equipment having been briefly described in "The Practical Engineer." The motors have field magnets of the Manchester type, with Paccinotti armatures. In starting a motor, a variable resistance is switched in to diminish the starting current, being cut out when the motor is fairly running. All the motors used are designed to run at 1,500 revolutions per minute, the speed being afterwards reduced by worm gearing. In the case of the 30-ton cranes used in the erecting shops for lifting locomotives, the load is lifted at a speed of 2 ft. 6 in. per minute at an expenditure of 70 amperes at 120 volts. The long traveling is performed at a speed of 100 ft. per minute, with an expenditure of 60 amperes at 120 volts, and the cross traverse at a speed of 50 ft. per minute, with an expenditure of 30 amperes at 120 volts. In the case of light weights the speed of lifting is 10 ft. per minute. In the case of the 15-ton crane, which has been provided in connection with a boiler-riveting plant, the crane is 50 ft. above the floor level, and all its movements are controlled by switches on the ground, a magnetic brake being provided on the armature shaft to arrest the motion as soon as a rivet hole has been brought into place for the closing of the rivet. The cost of repairs has, Mr. Webb states, so far been very small; no renewal of commutators has been necessary, but they are lightly skimmed up in the lathe about once in twelve months. The carbon switches and brushes are renewed once in six months.

NEW FREIGHT TRUCKS.—LOUISVILLE & NASHVILLE RAILROAD.

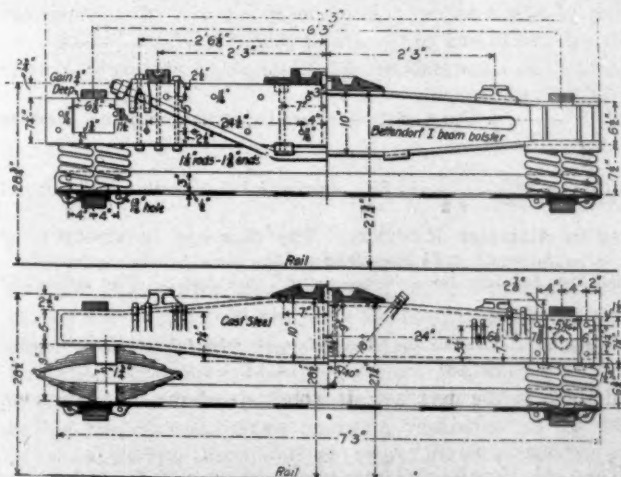
The drawing of new freight trucks in use on the Louisville & Nashville Railroad, from which the accompanying engravings were made, was received from Mr. Pulaski Leeds, Superintendent of Machinery.



Truck Fitted with Wooden Bolster.

The trucks are of the diamond, arch bar type, designed with the special object of bringing the bearing low enough to admit of using an efficient depth in the body bolster.

Three forms of truck bolsters are shown; one is the Bettendorf, another is of cast steel and the third is of wood, with truss rods. The different arrangements of springs are also il-



Showing Steel Bolsters and Spring Plank.

lustrated, and it will be noted that the spring plank is in the form of a channel of cast steel, the web of which is 1/2-inch thick, the ends being formed to receive the arch bars and columns. This form was chosen in order to obtain room for the 5 3/4 by 7-inch springs and at the same time to get the brake beams as nearly opposite the centers of the wheels as possible

with a reasonable wheel base. The brakes are hung from the top of the bolster in order to get the benefit of the springs in the brake connections. The form of this spring plank necessitated using cast steel and Mr. Leeds is now considering the advisability of extending the castings with wings under the columns in order to have the lips over the lower arch bar, now formed by the columns, as integral parts of the spring plank, furnishing a rigid guide for the arch bar 23 1/2 inches in length, which ought to serve the important purpose of keeping the truck square. This spring plank was designed so that it will meet the requirements of new trucks and it will also go in all the old trucks used on this system, all of which have a distance of 14 inches between the columns. The form of the spring plank gives it sufficient strength without undue weight, and to make it lighter large holes are bored through the web at intervals, as shown. It weighs 230 lbs., and the cast bolster weighs 650 lbs.

The wheel bases of these trucks are 5 ft. 3 in. and the height from top of rail to lower face of center plate is 28 3/4 inches for the wooden bolster, 28 1/2 inches for the cast steel bolster and 27 3/4 inches for the Bettendorf bolster. The National Hollow and the Sterlingworth brake beams are used.

The use of cast steel bolsters on this road is experimental as yet, they are to be used under 100 furniture cars now building. Mr. Leeds favors the cast steel bolster of the box form as being well adapted to resist all of the strains brought upon it, both vertical and transverse. The bolster and spring planks which have been made from this drawing and put into service were made by the Shickle, Harrison & Howard Iron Co. of St. Louis.

LOCOMOTIVE DESIGN.

The Working Stress of Materials.

By Francis J. Cole.

Crank Pins.

(Continued from page 125.)

A crank pin may be designed correctly for the stress at the wheel fit and yet be so reduced in size for the rod bearings as to fall below the curve of a beam of equal strength. When this occurs the greatest stress will be at this point instead of at the face of the wheel. This is shown in Fig. 7, the dotted lines indicate the shape of a solid circular beam of uniform strength, fixed at one end and loaded at the other with a single load W . The maximum bending moment at A is $W l$. For different points along its strength, this decreases directly as the distance from the load W . The form of a beam of this kind is a cubic parabola and the formula for its various diameters is:

$$y^3 = \frac{32 w}{\pi f} x$$

In which:

 y —the diameter for any distance x . f —the stress per square inch. x —the distance from load for diameter y . w —the load in pounds.

It may be also constructed from the diagram Fig. 6 by multiplying the load by the distance in inches and plotting the diameter found in the diagram for the corresponding moment, at intervals of one inch and drawing the curve to pass through the points so found. An approximate form given by Unwin is a truncated cone, whose small diameter is two-thirds of the diameter at the point of fixture.

The sizes of the crank pins for bearing surfaces must also be considered. This is taken as the projected area, or what is the same thing, the diameter multiplied by the length of the bearing surface. While certain pressures are suggested as representing what would be the most suitable for the purpose, providing ample surface with a moderate pressure per square inch, without going to the extreme in the matter of large surfaces, by the use of too large or clumsy sizes, it is often con-

venient to know how wide a range may be permitted and still keep within the bounds of pressures now in use on locomotives in successful operation. The pressure per square inch of bearing surface ranges from 3,500 to 5,800 pounds for the front or crosshead end of the main rod; about 4,200 pounds will be found most suitable for this purpose. The back end of main rod ranges from 1,850 to 2,670 pounds; about 1,700 pounds will be found most suitable for this purpose. For parallel connecting rods the range is from 850 to 2,100 pounds; about 1,000 to 1,200 pounds will be found most suitable.

Several instances will now be given of engines which came under the writer's personal observation for a number of years.

Ten wheel engines, giving six years' service, no breakages occurred with steel pins of not less than 70,000 pounds tensile strength. The following were the dimensions: Diameter of main pin in wheel, 6¼ inches; to center of main rod, 8¼ inches; to the center of parallel rod, 3 inches; diameter of cylinder, 20 inches; steam pressure, 165 pounds.

$$\text{Primary bending moment} = 20^2 \pi \times 165 \times 8.25 = 427,432.$$

$$\text{Support of parallel rod} = \frac{20^2 \pi \times 165 \times 3 \times 2}{3} = 103,620.$$

$$\text{Actual bending moment} = 427,432 - 103,620 = 323,812.$$

$$\text{Section modulus for } 6\frac{1}{4} \text{ inches diameter} = .0982d^3 = 23.97.$$

$$\text{Maximum fibre stress per square inch} = \frac{323,800}{23.97} = 13,500 \text{ lbs.}$$

Consolidation engines—Hammered iron main pins, several broke, tensile strength probably about 47,000 to 48,000 pounds per square inch. Diameter of main pin in wheel, 5

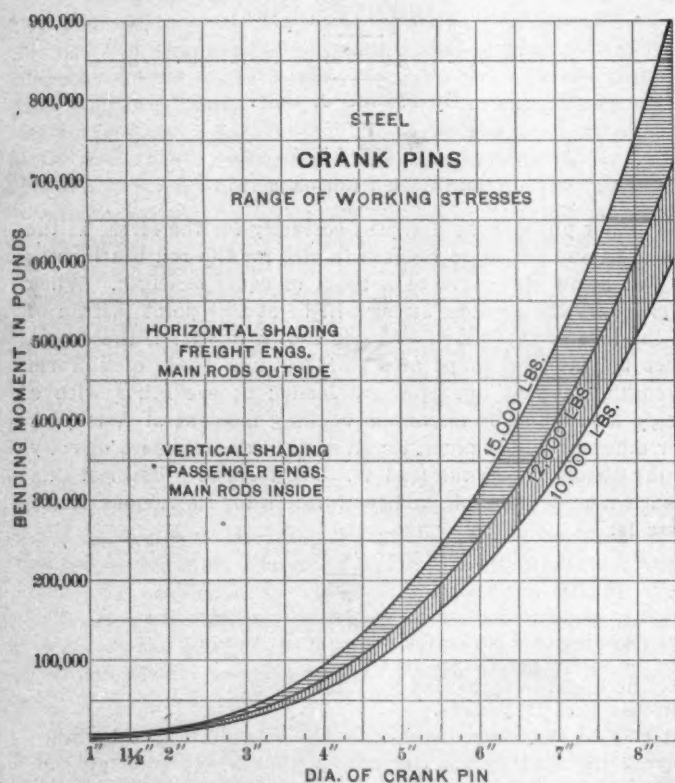


Fig. 6.

inches; to center of main rod, 7¼ inches; to center of parallel rod, 2½ inches; diameter of cylinder, 20 inches; steam pressure, 140 pounds— $20^2 \pi \times 140 = 43,900$.

$$\text{Primary bending moment} = 43,900 \times 7.125 = 312,787.$$

$$\text{Support of parallel rod} = \frac{43,900 \times 2.5 \times 3}{4} = 82,310.$$

$$\text{Actual bending moment} = 312,787 - 82,310 = 230,477.$$

$$\text{Section modulus for 5 inches diameter} = 12.27.$$

$$\text{Maximum fibre stress per square inch} = \frac{230,400}{12.27} = 18,800 \text{ lbs.}$$

Consolidation engines—Hammered iron main pins often break with a maximum fibre stress per square inch of 19,730 pounds.

Four wheel switching engines—Main pins break regularly after running two or three years. Steel and iron used for these pins with a maximum fibre stress of 29,000 pounds per square inch. It is remarkable that they lasted so long, however these engines made a very low mileage per month.

Eight wheeled American type—Back pins occasionally break. Steel pins, tensile strength about 70,000 pounds; maximum fibre stress, 14,510 pounds per square inch.

Eight wheel American type—No record of breakage in four

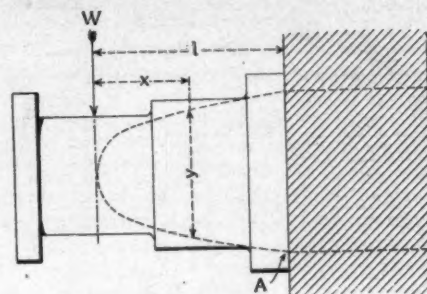


Fig. 7.

years. Steel pins, tensile strength about 75,000 pounds per square inch. Maximum fiber stress on back pin, 12,170 pounds.

Eight wheel American type—No record of breakage in six years with steel pins, tensile strength about 75,000 pounds; maximum fibre stress on back pin, 13,442 pounds per square inch.

Hollow crank pins at the present time are being used to a limited extent on a number of locomotives. Their points of superiority are lightness, increased strength for a given weight, and the partial removal of initial forging strains. Two ways of manufacture are available—to forge them hollow or to drill out the hole after forging. The former method has only a very limited application for crank pins of unusually large diameters when used with rods having straps, and when the collar of the pin is integral, as in Fig. 8, this permits of a hole of the same diameter being run entirely through the pin from end to end. Where solid end rods with bushings are used a loose collar is necessary in order to slip the rod over the crank pins. These loose collars must be secured either by reducing the end of the crank pin to a size suitable for screw threads and using one or two nuts, as shown in Fig. 9, or by the use of a bolt screwed into the end, either of the methods requiring a solid end to the crank pin.

The section modulus R of a hollow circle (Fig. 10) = $0.0982 \left(D^3 - \frac{d^4}{D} \right)$. For a section where $D=6$ inches and $d=3$ inches

$R = 0.0982 \times \left(6^3 - \frac{3^4}{6} \right) = 19.88$. For a solid circular section six inches in diameter $R = 21.21$. The decrease in strength of the hollow section is $\frac{21.21 - 19.88}{21.21} = 6.2$ per cent. The decrease

in weight is $\frac{94.25 - 70.69}{94.25} = 25$ per cent. For the above ratios and diameters the decrease in weight is about four times as



Fig. 8.

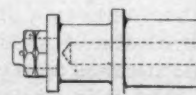


Fig. 9.



Fig. 10.

much as the decrease in strength. Where the material is oil tempered the hollow section is doubtless the best form, as the cooling strains are much less severe, permitting the oil to be applied simultaneously internally and externally. Whether

the increase of strength or decrease of weight is worth the extra expense of manufacturing these hollow sections is a question which at present there is not sufficient information at hand to answer definitely. Two facts seem clear, however: First, That with certain methods of treating steel, their use seems advisable. Second, Where reduction of weight is absolutely necessary (the decrease in weight is comparatively small, however) a two or two and a half-inch diameter hole in all but the largest engine will be found as large as it is advisable to use.

An account of the beneficial effect of oil tempering steel was published some time ago from some tests made on the Lehigh Valley Railroad of a broken crank pin before and after being oil tempered. The following is an abstract of the results:

Dimensions.		Test.				Remarks.
Size.	Length	Tensile	Elastic ten-	Ex- P. C.	Contrac-	
in.	in.	Strength	Limit	tion.	tion.	
0.499	2	88.970	39.880	17.25	43.50	Specimen cut from pin as received.
0.499	2	88.460	39.880	17.25	43.50	Specimen cut from pin as received.
0.500	2	94.320	39.720	16.85	21.49	Specimen cut from pin as received.
0.498	2	97.540	54.430	23.10	50.31	From piece of pin after boring hole 2 in. in diameter and oil-tempering and annealing.

Analysis: Carbon, .53; manganese, .59; phosphorus, .47; sulphur, .069; silicon, .170.

"The result of oil-tempering and annealing the same steel cut from the broken pin was an increase in tensile strength of 7.7 per cent., in elastic limit of 36.6 per cent., in extension of 34.9 per cent. and in contraction of area of 39.1 per cent."

Ultimate strength.....91,000 lbs. per square inch
Elongation.....25.06 per cent.
Elastic limit.....57,000 lbs. per square inch
Contraction.....54.46 per cent.

It is a fact, however, that the use of a high grade of open hearth carbon steel having a tensile strength of from 80,000 to 90,000 pounds, with an elongation of 22 per cent. in two inches and phosphorus not exceeding 0.05 will give very satisfactory results, provided the proportions are such as to keep the fiber stress within reasonable limits. Large fillets should be provided at the wheel fit, collars, etc., and sharp corners should be avoided whenever steel is used.

Corrections.

Typographical errors occurred on page 124 of our April issue as follows: In the seventh line of the second column for 0.0982 d read 0.0982 d³, and in the fifteenth line of the same column

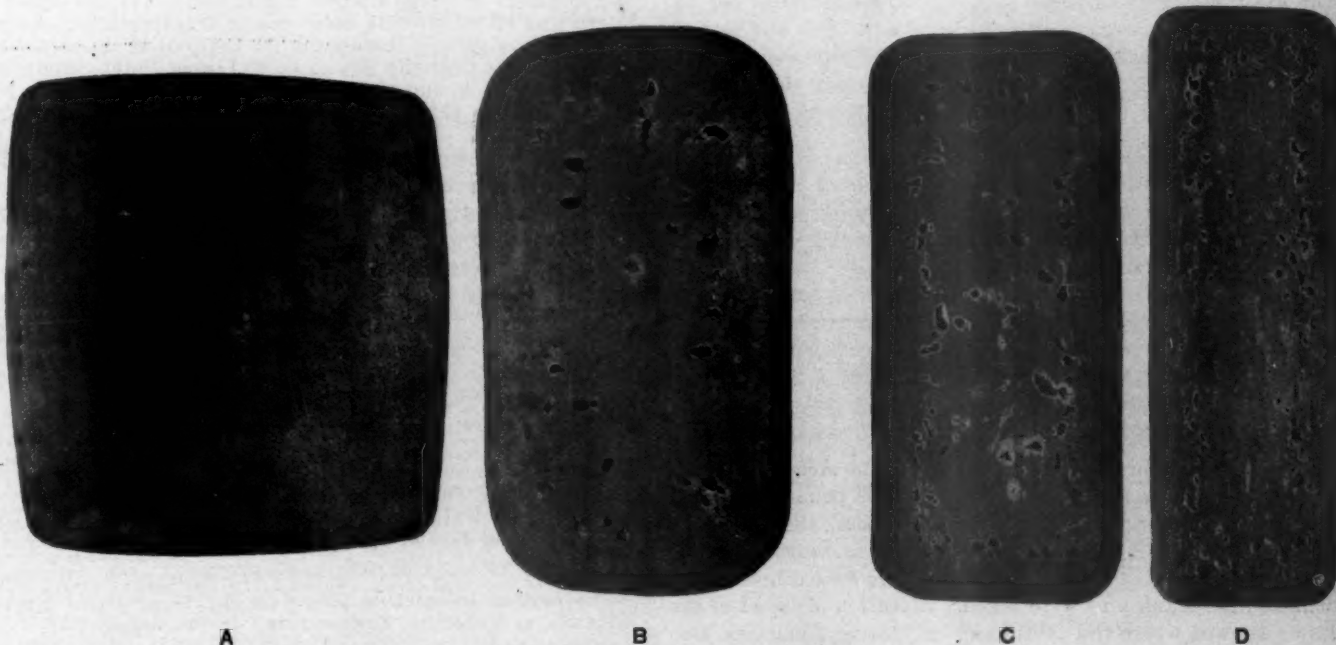
$$\text{for } d = \sqrt[3]{\frac{W l}{0.0982 d^3}}, \text{ read}$$

$$d = \sqrt[3]{\frac{W l}{0.0982 S}}$$

(The next subject treated by Mr. Cole will be "Driving Axles."—Editor.)

BOILER STEEL INGOTS.

By aid of the microscope the Baldwin Locomotive Works some time ago traced the causes for the failure of certain plates of boiler steel which fully met their requirements, both physically and chemically, to conditions of manufacture which undoubtedly have an important influence upon the wearing



Sections of Ingots, Reduced in Size.

From recent reports and experiments on the characteristics of steel alloyed with from 3 to 5 per cent. of nickel, commonly known as "nickel steel," this material seems well adapted for crank pins, and especially so for renewals in engines which have been improperly designed, where the length of the pin or its small diameter produces such a high stress that the use of the best and strongest material, regardless of its cost, is advisable, rather than incur the repetition of expensive breakdowns. Nickel steel possesses the valuable property of a ragged, irregular fracture, partaking more of wrought iron than the clear, sharp breakage peculiar to steel. A crack once started does not seem to extend through the entire piece so rapidly as in ordinary steel. From specimens tested at the Watertown Arsenal the elastic limit was over 100,000 pounds, and the ultimate strength 115,000 to 118,000 pounds per square inch. Tests of nickel steel used in the construction of the new locomotive at the Purdue University give:

qualities of the plates. A microscopic examination was made of some plates which had prematurely failed in service, which, however, had previously met all of the specifications as to strength, elongation, character of fracture and chemical constituents. It was found that the plates contained minute laminations, which would satisfactorily account for their action in service, and as they appeared to be due to the presence of blow-holes and segregation in the ingots from which the plates were rolled, an experiment was made to ascertain the probable presence or absence of such laminations in the products of the various steel manufacturers.

An ingot was ordered from each of six boiler steel makers, with, as we understand it, instructions to furnish an ingot from the regular stock of the works, one that would otherwise be made into plates, this being done with a view of obtaining a fair sample. These sample ingots were sectioned and the photographs show the appearance of the surfaces of four of them. The section "A" was taken from the lower third of a long ingot, while the others were taken at the centres of ordinary small ingots.

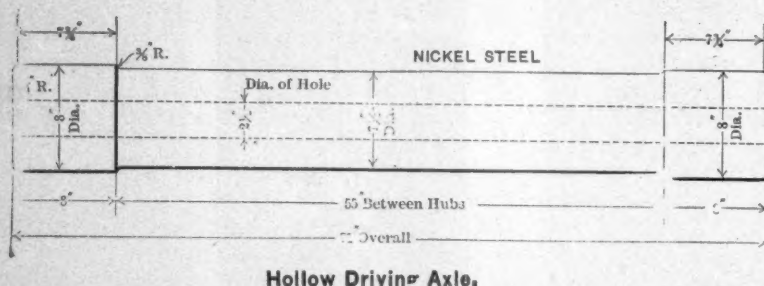
Segregation is apparent in all except section A, but it is most

marked in section B. All of the sections show blowholes, but section A the least, and only about the edges, while the others are badly honeycombed all over. The manufacturer's names would be exceedingly interesting in this connection, but we are not at liberty to print them.

This exhibit is suggestive of several important things. The manufacture of boiler plate is as important as the physical properties which are usually watched so carefully, because there appears to be danger of mechanical defects in the product which the usual tests do not expose. There is apparently good reason to believe that all such material should be rolled from large ingots, from which very large crop ends should be cut in order to avoid the segregation and honeycombing in the portions of the ingots that are used for boiler plate. In view of the higher boiler pressures and the evident tendency to increase still further (we know of one road contemplating using 225 pounds per sq. in. and throttling down to 175 pounds before the steam enters the cylinders) there cannot be too many precautions taken to avoid causes for failure of the plates. If these photographs show current practice among steel makers, and we believe they do, radical improvements in the making and rolling of ingots cannot be introduced too quickly and the manufacturers of these spongy ingots should lose no time in making and rolling ingots like the one in the section at A.

HOLLOW, NICKEL STEEL DRIVING AXLES AND CRANK PINS—PURDUE EXPERIMENTAL LOCOMOTIVE.

In the illustrated description of the new Purdue laboratory locomotive in our January issue of the current volume the hollow nickel steel driving axles and crank pins furnished by the Bethlehem Iron Company were mentioned. It was noted that the great mortality of these parts of locomotives has led engineers to seek for some metal of high elastic limit and elongation that would resist the severe alternating stresses to which they are subjected. The accompanying drawings show the designs adopted for these parts, the material used having the



Hollow Driving Axle.

following characteristics: Ultimate tensile strength, 91,000 pounds per square inch; elastic limit, 57,000 pounds; elongation, 25.05 per cent.; contraction, 56.45 per cent., the test specimens being two inches long between the measuring points. These parts are oil tempered, the axles were forged upon mandrills and the crank pins were bored. Attention is called to the fillets allowed where the axles and pins change diameters, also to the fact that the wheel fits are the largest portion of the forgings, except at the collars of the pins. This is a very important improvement, the object of which is to assure against fracture in the concealed wheel fit. Fractures will occur, if at all, at the weakest point which in these cases will not be in the wheel fits, but outside where cracks will be likely to be discovered when the rods are removed.

Mr. H. F. J. Porter, of the Bethlehem Iron Company, in an admirable paper read before the Western Railway Club in February, stated the advantages of hollow forgings and nickel steel for axles and crank pins, as follows:

The surface metal of solid forgings is apt to shrink on to the metal of the interior to such an extent as to crack it open. In order, therefore, to oil temper a forging with safety it should be hollow to allow the heat to be extracted equally from the interior and surface metal.

Annealing lowers the ultimate strength and elastic limit of steel, but increases its toughness or ductility, as shown by the elongation and contraction in test specimens. Oil tempering

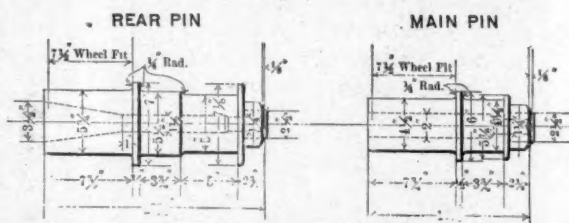
not only restores the ultimate strength and elastic limit, but increases the elongation and contraction very considerably.

When it is remembered that a severe compressive stress, sometimes closely approaching the elastic limit, is applied to the metal of pins and axles by forcing them into wheels, it is not surprising that their life is short at the point where this stress is applied. For such service as is required of crank and crosshead pins, axles, piston and connecting rods, and all forgings subjected to stresses alternating from tension to compression, a metal possessing the very highest elastic limit possible should be supplied. Such a metal can now be obtained by an alloy of the steel and a low percentage of nickel, and by oil tempering. Test bars of this metal, 1/2 inch in diameter and 2 inches long between measuring points, show the following physical properties:

Tensile strength.....	80,200 to 90,000 lbs. per sq. in.
Elastic limit.....	50,000 to 60,000 lbs. per sq. in.
Elongation.....	25 to 22 per cent.
Contraction.....	60 to 50 per cent.

Many railroads are now taking up the use of this metal generally, having tested it experimentally and found to their satisfaction that by a small initial increased expense they can save largely by having fewer breaks with their attendant delays and damage.

A high price is paid for coal in the California Mountains. The Consolidated Coal Company, whose mines are on the Baltimore and Ohio Railroad near Cumberland, Md., ship considerable coal to San Francisco for smithing purposes, and the cost of the coal at the mines and the price at which it is sold to consumers in certain parts of California has developed an interesting situation with reference to transportation charges. The company gets 85 cents a ton for the coal at the mines and then it is sent over the B. and O. to Locust Point, where it is loaded on vessels and goes around the Horn to San Francisco. From there it is shipped by rail to the interior points, and then



Hollow Crank Pins.

placed in sacks and carried on mules to the small mining settlements scattered through the mountain. This coal is retailed in these settlements, some being hundreds of miles from the railroad, at \$100 a ton or 5 cents a pound.

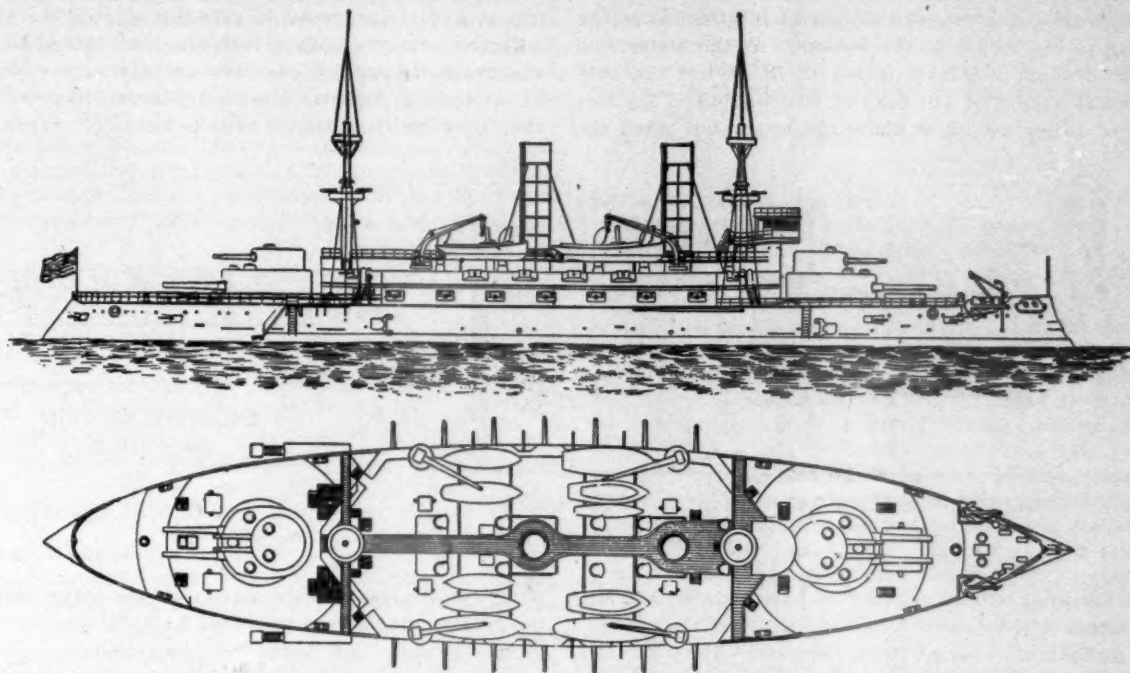
The cost of locomotive power on the 16 principal English railways, as stated in "Engineering," in the second half of last year, was as follows: Great Central, £194,626, giving an average of 6.31d. per train-mile run; Great Eastern, £377,164, giving an average of 8.06d. per train-mile run; Great Northern, £424,851, giving an average of 8.59d. per train-mile run; Great Western, £781,798, giving an average of 8.47d. per train-mile run; Lancashire and Yorkshire, £347,151, giving an average of 8.93d. per train-mile run; London, Brighton & South Coast, £213,019, giving an average of 9.78d. per train-mile run; London, Chatham & Dover, £102,154, giving an average of 9.97d. per train-mile run; London, Tilbury & Southend, £25,255, giving an average of 9.84d. per train-mile run; London & North-Western, £857,833, giving an average of 8.57d. per train-mile run; London and South-Western, £295,836, giving an average of 8.34d. per train-mile run; Metropolitan, £49,955, giving an average of 7.73d. per train-mile run; Metropolitan District, £24,016, giving an average of 6.70d. per train-mile run; Midland, £882,355, giving an average of 8.80d. per train-mile run; North-Eastern, £691,019, giving an average of 10.82d. per train-mile run; North Staffordshire, £53,701, giving an average of 9.38d. per train-mile run; and South-Eastern, £177,115, giving an average of 9.46d. per train-mile run. Of course, the weight of trains, the relatively high or low cost of coal or coke, and the gradients which have to be overcome, largely explain the divergencies indicated by this summary.

THE "KENTUCKY" AND "KEARSARGE."

These two battleships, built from the same plans and launched at the yard of the Newport News Shipbuilding & Dry Dock Company at Newport News, Va., March 24, were authorized by act of Congress approved March 2, 1895, the contracts being signed January 2, 1896. When completed they will have cost about \$4,000,000 each, and for their draft will carry

are twelve 6 pounders and eight more of this size are located on the berth deck, forward and aft. A number of 1-pounders and Gatlings are provided for the fighting tops.

The armor of the 13-inch turrets is 15 inches thick, except in front, where there is an additional two inches. The armor of the 8-inch turrets is 9 inches, except in front, where it is 11 inches thick. The main turrets are of the elliptical type; they are oval in plan, with the front plates inclined



United States Battleships "Kentucky" and "Kearsarge."

the heaviest batteries afloat. There is no premium upon speed obtained in excess of the requirement, but a forfeit of \$100,000 per knot is imposed for failure to obtain the specified speed of 16 knots. The most remarkable feature of these ships is the double decked turrets, the lower ones carrying 13 inch guns and the upper ones 8 inch guns. There are five torpedo tubes, two on each side and one at the bows.

The chief features of the ships are given in the following table:

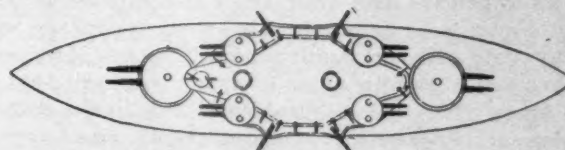
Waterline length	363 feet
Beam	72 feet 2½ inches
Draught	23 feet 6 inches
Freeboard forward	14 feet 3 inches
Freeboard aft	13 feet 3 inches
Displacement	11,525 tons
Speed	16 knots
Coal supply	410 tons
Horse power	10,000
Armor, nickel steel:	
Waterline belt	16½ inches
Side armor above belt	6 inches
Turret armor	17 and 15 inches
Barbette armor	15 inches
Conning tower	10 inches
Protective deck	2½ inches
Armament:	
Main battery	4 13-inch guns
Submain battery	4 8-inch guns
Secondary battery	14 5-inch R. F. guns
	20 6-p'nd'r R. F. guns

The small diagram of the gun plan of the "Indiana" serves to illustrate the contrast between her class and that of the new ships. In the "Indiana" eight 8-inch guns were mounted in four turrets at the corner of the central armored battery, for the purpose of training four guns on either beam or six guns directly ahead or astern, but in practice it was found that these guns interfered with the use of the 13-inch guns, and in the new ships the double deck plan was adopted. This arrangement is a bold venture, which is considered decidedly questionable, owing to the liability of disabling four guns with one successful shot.

The broadside battery of the new ships of fourteen 5-inch rapid fire guns is a noteworthy feature. Each of these guns fires through an arc of 90 degrees, and the gunners are protected by 6 inches of Harveyized armor. On the deck above

slightly and the rear plates vertical. This is an improvement on the old form of circular turret, in which there was more room than necessary at the side and too little at the rear of the guns. There are three sighting hoods, one in the centre for the man who operates the turning machinery of the turret and one on each side for the gunners.

The conning tower is just below the pilot house and abaft the forward turret. It will have armor 10 inches in thickness, with a tube 7 inches thick leading down through the armored deck, for the protection of the usual mechanical and vocal means of communication. The ships carry two military



Gun Plan of the "Indiana."

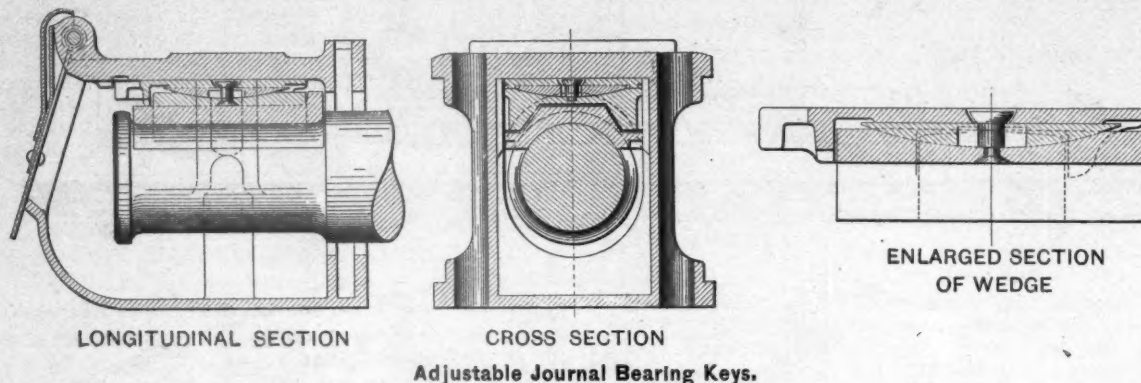
masts, each of which is fitted with electric signals. The lower masts serve as air shafts.

The ships will be driven by twin screws, actuated by triple expansion engines of the direct action, vertical, inverted type. The cylinders will be 33½, 51 and 78 inches in diameter, respectively, with a common stroke of 48 inches. They are designed to develop, together with the auxiliary engines for the air and circulating pumps, a collective horse power of 10,000, when making 120 revolutions a minute. Steam will be furnished from five boilers, three double-ended and two single-ended, in four water-tight compartments. We illustrated one of the single-ended boilers in our issue of June 1897, page 198. The working pressure will be 180 pounds to the square inch. There are to be 90 auxiliary engines. The turrets and ammunition hoists will be operated by electricity.

The hulls are built of steel throughout, and are double, consisting of an inner and outer shell, spaced apart a little over three feet by the longitudinal girders and transverse frames.

At their intersections the frames and girders are riveted together and their flanges are riveted to the inner and outer shells, forming a series of water-tight cells, which will tend to restrict the damage and localize the effect of a slight collision or of striking some submerged obstacle. The double hulls round up into the sides of the ship and end in a shelf four feet below the load water line at mean draught. This shelf serves as a support for the side armor belt. This belt is $7\frac{1}{2}$ feet in mean depth, with a maximum thickness of $16\frac{1}{2}$ inches at the top, tapering to $9\frac{1}{2}$ inches at the bottom. At the water line on the mean draught it is $13\frac{3}{4}$ inches thick. When the ship has her normal supply of 410 tons of coal on board $3\frac{1}{2}$ feet of this belt of armor will show above the water, but when she

use of the present M. C. B. key, the top of which presents a convex surface for the box to rock upon, and any tendency of the box to take an inclined position by reason of any of the above mentioned causes immediately shifts the position of the load away from the center of the journal bearing key, thereby raising the unit pressure to such a degree as to materially affect the lubrication of the journal. With the constant increase in speed of trains, particularly of freight trains, and the increase of capacity of freight cars, together with the tendency toward insisting that cars shall carry their maximum tonnage, it becomes necessary to eliminate every factor that in any way contributes toward increasing the friction between the journal and its bearing. When a uniform



is loaded to her total bunker capacity of 1,210 tons, only 2 feet of the belt armor will be above the load line.

A belt of nickel steel 5 inches thick rises above the main belt of side armor and extends up to the level of the main deck and runs fore and aft from the center of the forward barrette to the center of the after barrette. From the main side armor belt there rises a protective steel deck, which slopes at the sides down to about the water line, and rises in the center of the ship a little above the water line. On the slopes forward of the machinery and boiler spaces this deck is 3 inches thick; aft of the machinery spaces it is 5 inches thick, and on the flat it is $2\frac{3}{4}$ inches. Above the protective deck cofferdams are worked inside the casement armor, extending fore and aft along the sides of the ship about the machinery spaces. These are filled with compressed, fireproofed, American cornpith cellulose.

These ships have light draft, small area exposed as targets, heavy armor, large guns, and fair speed, which they will be able to attain with comparative ease. They will carry enough coal to steam 6,000 miles at ten knots per hour, and 4,000 miles at 13 knots. They will be fitted up as flagships, and the full complement will consist of 40 officers and 480 men.

ADJUSTABLE JOURNAL BEARING KEYS.

The object of the design of journal bearing key illustrated in the accompanying cuts was to insure having at all times, and under varying conditions, a uniformly distributed load over the entire length of the journal bearing. Very little attention has been given this feature of journal bearing keys in the past, if we may judge from the number of such that meet these requirements when trucks are new and in perfect condition, but do not provide means for successfully overcoming the poor conditions more frequently met with which develop later in the service of the truck.

Among these conditions may be cited the spreading of pedestals or bottoms of truck frames; equalizers or box springs out of position and bearing faces of equalizers not in parallel planes, all of which tend to throw the journal box out of its normal position and to apply the load to the journal bearing key at a point on one side of the center of the journal.

An eccentricity of bearing of the load often occurs with the

unit pressure can be maintained over the entire length of journal bearing, under reasonably poor conditions, one of the worst factors causing "hot boxes" will be removed.

In the key illustrated, which is the joint invention of Mr. A. M. Waitt and Mr. H. F. Ball of the Lake Shore & Michigan Southern Ry., the adjustment, to suit the irregular positions of the box, is obtained by means of a sliding plate, interposed between two other members which practically conform in outline to the M. C. B. standard key, their external dimensions being exactly the same.

The slide plate is made either of a segment of a cylinder, or of a segment of a sphere, in shape, the first mentioned furnishing adjustment lengthwise of the journal only, while the latter gives adjustments in both directions. The three members are loosely connected by a rivet, simply for ease in handling. No strain is put upon the rivet in service.

This key provides a maximum bearing surface for the box to rest upon, it adjusts itself permanently to the variations in the position of the box, allowing the brass to maintain its normal position with respect to the journal, and at the same time presents a solid mass of metal through which the load is transmitted to the journal, practically the entire length of the key. This latter feature aids materially in stiffening the brass when it becomes worn thin.

Mr. Waitt informs us that these keys have given exceedingly good service for many months on the Lake Shore road, and that in several cases of cutting and heating with the ordinary wedge the bearings were found to be worn from $\frac{1}{4}$ to $\frac{3}{16}$ in. thinner on the inside than on the outside edge. Upon the application of the self-adjusting wedge to these boxes the uneven wear and also the trouble from heating and cutting disappeared.

SHIP CANAL—BLACK AND BALTIC SEAS.

In some of the foreign technical papers statements have been printed in regard to the beginning in the spring of the present year of work on the construction of a ship canal between the Black and Baltic Seas. The canal was supposed to be large enough for the largest ironclads, and 17 great cities were supposed to be planned along its course. We are informed by a note in the "Messenger of the Russian Ministry of Ways and Communications" that there is not the slightest foundation for such reports.

Communications.

ELECTRIC CRANES VS. TRANSFER TABLES.

Editor "American Engineer:"

I have read the article on "Cranes vs. Transfer Tables," page 126 of the April issue of the "American Engineer."

The question is covered quite fully in the article as written; and there does not seem to be anything further to be said on the subject, for the reasons as explained in the article, that in building new shops where there is ample room for placing tracks conveniently, it is preferable to use tracks as suggested and dispense with the transfer pit, necessary table, etc. The subject is aptly explained in the sentence, "Overhead cranes may be regarded as transfer tables placed inside and overhead; while they perform the only function a transfer table is capable of, they are also in constant requisition for lifting the heavy details of the engines." Nothing more can be said on the subject.

JOHN PLAYER,

Supt. Machinery, Atchison, Topeka & Santa Fe Railway.
Topeka, April 7, 1898.

Editor "American Engineer:"

When the volume of work is sufficient to warrant the installment of an electric crane, as between that and the transfer table it is the writer's opinion that there can be but one choice, viz., that of a crane.

G. W. STEVENS,

Superintendent Motive Power Lake Shore & Michigan Southern Ry.
Cleveland, April 11, 1898.

Editor "American Engineer:"

I have read the editorial on the subject of "Electric Cranes vs. Transfer Tables," and I beg to state that in my opinion the advantages of the longitudinal plan is generally overdrawn, and the summary manner in which the old-time transfer table is disposed of by ascribing to it the "limited purpose of shifting engines sideways" is another illustration of the narrow channel in which great minds sometimes run. The statement that the transfer table makes an undesirable break between shops is true, and this is the only serious objection that can be advanced. It is also true that the table and crane have certain functions which are to a limited extent identical, but the purposes of neither one can be altogether performed by the other.

As between the two plans, it is in my judgment largely a matter of taste and circumstances, each having its own peculiar advantages, with the cross track most in favor for the utilization of space and convenience. The table, of course, is a necessary adjunct to the cross track plan, and in this connection cannot profitably be dispensed with, and there are innumerable purposes aside from the moving of engines which the table will accomplish with a rapidity not possible with the crane.

JAMES M'NAUGHTON,

Superintendent Motive Power Wisconsin Central Lines.
Waukesha, April 13, 1898.

Editor "American Engineer:"

I have read with a great deal of interest the article on "Electric Cranes vs. Transfer Tables," on page 126 of your April issue. The views you give on this subject are full, and coincide with my views, which are borne out by practical experience.

I must say, that previous to putting up electric cranes in our shop, at Mt. Clare*, I was a little skeptical about longitudinal erecting shops, and leaned somewhat towards the table and cross tracks, but the experience I have had since these cranes have been put in has convinced me that shops with longitudinal tracks are preferable.

Our erecting shop is of the longitudinal kind with three tracks, one on each side of the center track, which are used for erecting purposes. The center track is used for disconnecting engines previous to their being placed on the side tracks, placing engines on their wheels after being finished and for putting finishing touches on them.

With the system of longitudinal tracks and electric cranes, there is very little handling of engines. They are taken off the wheels, put on blocks on side tracks, and the wheels are picked up by the crane, put on a car and run to the machine shop. In the case of cross tracks and transfer tables, when the engines

*See "American Engineer," November, 1897, page 365.

are lifted off the wheels it is necessary to handle the wheels by hand on the table.

Another matter in connection with this is the available room; with the longitudinal tracks it being much less with the cross tracks. In our present erecting shop we can put ten engines on each side track and generally have four or five on the center track, making an average of 24 engines in a space of 377 feet long and 72 feet wide. If we had this number of engines in a shop with cross tracks, it would take at least a space of from 500 to 550 feet long and the same width as the above mentioned shop in order to get around the engines.

HARVEY MIDDLETON,

General Superintendent Motive Power, Baltimore & Ohio Railroad.

Baltimore, April 9, 1898.

Editor "American Engineer:"

Your statements in regard to "Electric Cranes versus Transfer Tables," in your April issue, are rather broad, and I must say that I cannot altogether agree to them. The so-called longitudinal plan in distinction from what might be called the stall plan, has certainly many advantages, but in my opinion it is applicable to shops for new work rather than for repairs. As far as the actual work done on the engines is concerned, I think that better light can be obtained by use of short stalls or pits with an opportunity of better taking care of the material handled without getting in the way of other work. In the longitudinal plan at least one track must be kept clear for its full length in order to get engines out when they are ready, unless it is proposed to pick an engine up and take it over everything else for the full length of the shop—not an easy proceeding and one fraught with considerable danger. Very heavy cranes are needed for this purpose, and a crane large enough to handle a locomotive in such a manner is entirely too large for the greater proportion of the work to be done.

While a transfer table certainly occupies some room, yet a certain amount of such room is needed alongside of the buildings in order to obtain sufficient light. It is not difficult for men to cross a transfer table pit, and it is not necessary or advisable that material should have to be carried across. While a transfer table does not lift the material, it can certainly handle it more quickly than a crane, that is, such material as a truck load of bolts or lumber.

You also lose sight of the fact that very few shops are for locomotive repairs alone, but must take care of passenger and freight cars as well, and that you cannot well handle a 70-foot passenger car with a traveling crane, to say nothing of a freight car as a whole.

I presume you know that we are building new shops, and while we may not be making an entirely "scientific use of the imagination," as we propose to use a transfer table, yet we think that we have an eminently practicable design, as well as one which may be operated very economically. Instead of having several transfer tables, we have but one, and this one is nearly 800 feet long, all of our shops being on this single table, thus overcoming one of the principal difficulties in the average shops, i. e., the getting of material from one group of shops to another except by wheelbarrow. In fact, our plan may be compared with that of one of the modern 20-story buildings if laid on the ground, our transfer table taking the place of the elevators and being used in the same way to furnish almost the sole means of communication between the various departments. This will, of course, be an electric transfer table of comparatively high speed, and there will be a crew on it at all times, just as there would be on an elevator. It will carry not only rolling stock but all manner of materials. Of course, there will be overhead traveling cranes in the shops and they will be lighter and consequently much quicker and better adapted, as I have said, to handle the majority of the work than cranes large enough to lift a locomotive.

TRACY LYON,

Master Mechanic Chicago Great Western Railway,
St. Paul, April 6, 1898.

Editor "American Engineer:"

I may say that I am entirely in accord with the short editorial on electric cranes vs. transfer tables on page 126 of your April issue, but to follow out the suggestions contained it requires a long narrow shop building, and when it is a case of very large

capacity the shop becomes extremely and inconveniently long when using parallel tracks. The lay of the ground and the consideration of possible future extension with increase of capacity must be considered when deciding between the two plans of parallel or cross tracks. In 1882 the erecting shops at Roanoke were arranged after full consideration on the plan of parallel tracks, using rope driven overhead cranes, and I recollect having a long discussion with the late Mr. Howard Fry on this same subject in the fall of 1881 with special reference to the use of rope driven cranes for this purpose, electric cranes not then having been developed.

R. P. C. SANDERSON,

Division Master Mechanic Norfolk & Western Ry.
Roanoke, Va., April 13, 1898.

BALDWIN LOCOMOTIVES FOR CHINA.

Editor "American Engineer:"

I think the following items of news will interest your readers: The Russian Company, of China, has ordered 20 locomotives from the Baldwin Locomotive Works for the branch line from Port Arthur to the main Mandjarin line.

A combination of American contractors is negotiating in St. Petersburg for the construction of wharves and docks in Vladivostok, the eastern Russian port on the Pacific.

A. ZDIARSKI.

St. Petersburg, April 6, 1898.

DRAFTSMEN FROM TECHNICAL SCHOOLS.

Editor "American Engineer:"

I have read the first editorial paragraph on page 126 of your April issue and from my experience I think that there are probably several reasons for the state of affairs you referred to. In the first place the young engineers just out of technical schools are practically of no use in a railroad drafting room. I have had experience with some of them, who were so utterly conceited that they made themselves nuisances. They have no practical experience whatever, or at least to such a limited extent that all you can do with them is to set them at work tracing. With many of them theory predominates and they require so much watching and instruction that they are more trouble than they are worth.

Another reason for our difficulty is that local conditions at the places of employment on railroads are not always of the most pleasant nature, and young men with some experience prefer to go to large cities, rather than to the places where shops are located and where plenty of hard work but little amusement is to be obtained. A man with a half dozen years' practical experience in drawing office and shop, with good common sense and but limited technical education, is generally of much more value to his employer than the man who graduates first in his class, but has no shop experience or drawing office practice. We have a good many applications from men of the latter kind, but I have always felt obliged to decline to engage them.

April 5, 1898.

SUPERINTENDENT M. P.

Editor "American Engineer:"

Your inquiry in the April issue, "Why is it with all the technical schools preparing young engineers, it is so difficult to secure satisfactory draftsmen?" recalls my experience in employing young men just graduated from technical schools. First, they were failures as draftsmen and had to be educated to the business in hand, the defect appeared to have been in their schooling, and was an illustration of the old issue, "Theory vs. practice." The young men appeared to be well posted in the theory of mechanical drawing, and would make a general plan of the machine when they were made to understand just what was wanted, and were surprised when the work was condemned on the ground that it "could not be worked from."

They attempted to show too much; for instance, the plan of a box car would show the outside siding, then the braces and studding would appear in dotted lines, the inside sheathing by other dotted lines; rods and bolts were also dotted, when not to the front, the result being a tangle of lines which no person but the maker could understand. Remonstrance would be met with the indignant remark, "Why, it is all there," which was too true.

In making detail drawings they did not understand the importance of making different views, showing all sides and in-

dicating different kinds of material. In laying out a locomotive frame or car sill showing location of holes, lugs, gains and mortises, the sum total of measurements would sometimes be greater or less than full length of the piece. Of mortises and tennons they knew nothing. It was some time before they could realize that the mechanics who had to work from the drawings were not draftsmen, or mechanical engineers, and that plans must be made that could be read and understood by the ordinary run of shopmen. Where 500 or 1,000 were employed the time of the foremen was too valuable to give more than a brief space to explain plans and hunt out errors. When the young men realized how much there was to learn and what a large world it is, and if they had the energy to work for improvement they in time became valuable men.

Utica, N. Y., April 8, 1898.

JAMES M. BOON.

Editor "American Engineer:"

Allow me to offer the following reasons for the condition stated in the editorial paragraph in your April issue: There are probably a number of reasons for the fact that difficulty is found in securing men for such positions as are there mentioned, among which these may have their influence: The call is, as a rule, for men who have had some experience in the business and who may be trusted to go alone in making plans and in designing machinery. The young man just from an engineering school is usually a fairly good, often an excellent, draughtsman; but he has still to acquire a knowledge of the special line of work in which he is to make himself a place. He is not wanted for purposes of training by those who thus advertise their needs, but to do work involving experience and carrying with it responsibilities which the youth just out of college is unprepared to assume.

On the other hand, once these men do secure their positions, and do acquire so much of knowledge of the special work of an establishment and so much of experience as makes them capable of doing work without nursing, and of accepting responsibilities safely, they are pretty sure to be the men who are the last to be discharged; since they, more than any other class, combine theoretical with practical knowledge, are best fitted to meet emergencies, and to solve new and difficult problems, and thus are not to be found—at least not so frequently—as the less fortunate old-style members of the craft. A good man, fitted by nature for success in mechanical pursuits, for example, with the right business qualities and having a good engineering college training, rarely loses his hold upon business once he secures it. He rarely drifts about very much, and is rarely to be found by those who seek him in the market-place.

There are, as a matter of course, and particularly since engineering courses have come to be considered particularly promising, and especially "chic," many young men, in the aggregate, who go into this work with less fitness for it than for law, medicine, or even the ministry, and they must inevitably fall out again in the process of time and with that evolution that insures "the survival of the fittest"—the fittest to survive, in that branch of industry. But these are probably less numerous, proportionately, than in any other profession; for in no other professional school is the worthless material pruned out so mercilessly and so effectually as in the engineering schools.

As evidence of the probable correctness of this supposition, I may say that I have, for years, been in the habit of keeping two files, the one of letters from graduates desiring positions; the other from would-be employers of this class of men. My file of the first sort contains individual applications in very small numbers; my other file contains letters from employers; and, often, one such letter will contain applications for two or three, and sometimes a half-dozen, men. With our graduating classes—of late years a hundred or more, last year of a hundred and thirty—there is, necessarily and as would be expected, some delay, occasionally, in finding just the right peg to fit each prescribed hole, and now and then an alumnus is thus delayed in finding his first place; but this delay rarely affects more than an exceedingly small proportion of the class, and, once a peg is well fitted in its place, it is apt to stay there, and so firmly that it is difficult for any chance advertiser for assistance to get it out. I have, for now a quarter of a century, been sending out men of this class; my daily mail is made up, in no small proportion, of correspondence with them, but correspondence rarely indicating a displaced peg, and usually simply a friendly note to tell of progress, advancement, success. There must be about fifteen hundred young men in the United States

(not a few in foreign countries and also including a large proportion of the now responsible officers of the United States Navy), on whom I have such claims, and many of them make a point of now and then, often at intervals of years, to be sure, reporting themselves, in person or by mail; but a letter of complaint with fortune or indicating a failure in life is extremely rare.

Possibly the fact that, in all important schools and colleges of this class, the administration is accustomed to keep such files as I have referred to may have something to do with the difficulty mentioned. Mr. Cornell used to say that whenever anything was seriously needed by the university, it might be taken for granted that "the man is walking around, somewhere, who wants to provide it, and whose only difficulty is in finding his way to it." The real problem, in the endeavor to effect the desired result, is that of enabling the two parties to the needed contract to find each other.

In so far as defects of preparation give rise to difficulties of the sort under discussion, they come, usually, of two principal sources: Lack of natural fitness for the business; lack of experience and knowledge of the minor details of the craft. Many a young man can conduct a steam-engine or boiler trial or figure out a "calorimetric analysis," but yet cannot tell what is meant by a "soft patch," or how to start an engine without knocking out a cylinder head, or even how to properly lay off the center lines of his drawing, or to stretch his paper, or to decide whether to use "Whatman's" or brown paper. Such details must come of experience in the apprentice's place, and no man is safe in a higher position until these things are made familiar. "Pride goeth before a fall" is a good proverb to be kept in mind by young graduates. Fortunately, the engineering graduate is exceptionally sensible and modest—if of the right material.

R. H. THURSTON,

Sibley College, Cornell University.

Ithaca, N. Y., April 11, 1898.

RAILROAD CLUB REPORTS.

Editor American Engineer:

A short time ago, one of the technical papers printed a letter criticising one of the railroad clubs for taking up subjects with which its members were not familiar, and as I am a member of all of the clubs I was hit by it and felt somewhat hurt. If we do not talk about matters outside of our regular routine how can we avoid becoming very narrow? I think the author of the letter referred to takes a narrow view of the possibilities offered by the clubs for the broadening influences they possess over the members.

I defend the clubs against such criticisms, but I bring up another matter that is very troublesome to me and that is, in regard to the method followed by some of the club secretaries in printing the proceedings. I understand that there is an association among the secretaries, the object of which is to unify the methods of reporting the proceedings. I object very strongly to the printing of advertisements and texts of proceedings upon opposite sides of leaves of the pamphlets. I object to the appearance of advertisements in the proceedings at all, but especially inside with the part of the pamphlet that is supposed to be devoted to the records of the meetings. This practice can not be defended and it is in such bad taste that I should think many protests would be raised. Who will bind such papers for permanent record?

Another objection that I will raise is to the lack of system in numbering the pages of the annual volumes of the reports. There ought to be uniformity in this respect and each volume should be paged continuously throughout. I speak from the standpoint of one who keeps track of all of the work of the different clubs and as I keep an index of the papers and discussions that I want to refer to again the present practices are annoying. Then I do not see why members want to see so much of the minor detail of the discussions of motions on record. For instance, Mr. Black has not heard from Mr. White, etc. Who wants his book shelves loaded with this?

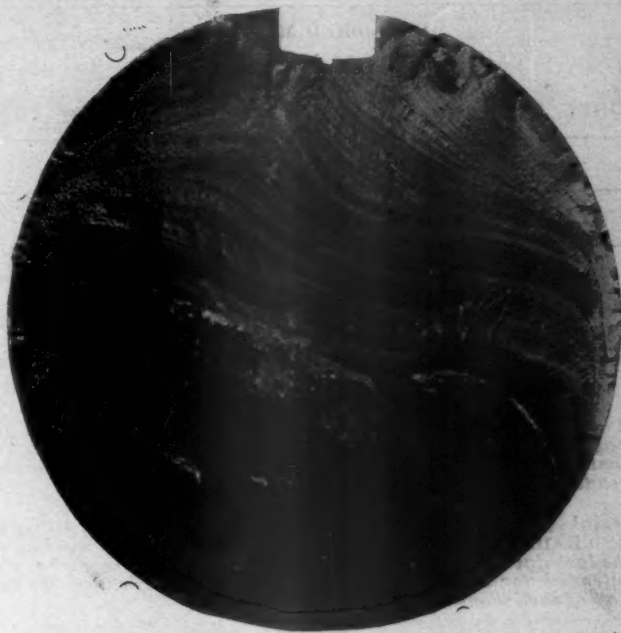
In order to avoid the appearance of grumbling without suggesting a remedy, I will recommend the club secretaries to examine the reports from the different clubs. They will find in the reports of one of them. It is not necessary to mention which, all of the features I consider desirable and if the reports are worth printing at all they are worth printing in such a way as to make creditable permanent records. It is a pity that at the present time there is only one club whose proceedings are brought out in shape for binding. And yet the discussions before the clubs are worth permanent preservation.

I wonder that the clubs do not see this point, and if you desire and do not consider me too critical you may publish this letter.

April 10, 1898.

KEY WAYS IN DRIVING AXLES.

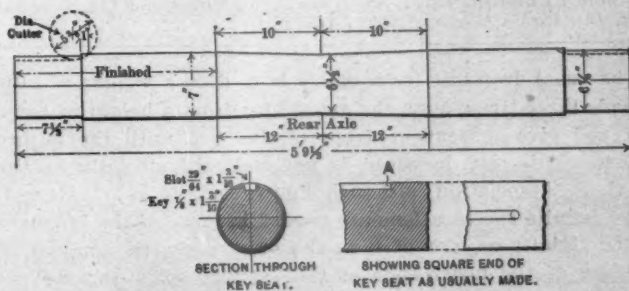
The photograph from which the accompanying engraving was made was taken from a fractured steel, locomotive driving axle which had been running on the Chicago, Burlington & Quincy Railroad from May, 1893, until January 27, 1898, during which time it had made 217,155 miles, and the journals had worn from a diameter of $7\frac{1}{4}$ inches to 6.29-32 inches. This mileage is good and the failure is exceedingly interesting, be-



Photograph of Fractured Axle.

cause it illustrates the great importance of little things in the designing of such parts, which are not to be offset by using the very best of material or by enlarging diameters, even to a considerable extent. In other words failures are not always due to inferior or insufficient material.

In this case the breakage is believed to be due to the form of the key seat for securing the driving wheel upon the axle, and a glance at the fractured end shows that it occurred at the key-way, and probably started at the indentation left by the drill point at the end of the key-way, the drill being used to cut



Improved Method of Cutting Key Ways.

out the end of the slot. Key-ways are often cut in this way, a drill being entered at the end of the slot while the key-way is slotted out by a tool that is allowed to "run out" into the drill hole, leaving a sharp shoulder, as shown in the small sketch.

A great improvement has been made in the cutting of key-ways on this road by employing a rotary cutter of the proper width, and the inner end of the slot is left as shown in the drawing of a worn driving axle, for the class "A" and "B" engines of this road. This cutter is $5\frac{1}{2}$ inches in diameter and tapers the end of the slot in such a way as to avoid the sharp corner of the other method. This is a matter of design which appears small at first, but it is clearly of very great importance.

(Established 1832.)

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EDITORIAL ANNOUNCEMENTS.

Advertisements.—Nothing will be inserted in this journal for pay, EXCEPT IN THE ADVERTISING PAGES. The reading pages will contain only such matter as we consider of interest to our readers.

Special Notice.—As the AMERICAN ENGINEER, CAR BUILDER AND RAILROAD JOURNAL is printed and ready for mailing on the last day of the month, correspondence, advertisements, etc., intended for insertion must be received not later than the 20th day of each month.

Contributions.—Articles relating to railway rolling stock construction and management and kindred topics, by those who are practically acquainted with these subjects, are specially desired. Also early notices of official changes, and additions of new equipment for the road or the shop, by purchase or construction.

To Subscribers.—The AMERICAN ENGINEER, CAR BUILDER AND RAILROAD JOURNAL is mailed regularly to every subscriber each month. Any subscriber who fails to receive his paper ought at once to notify the postmaster at the office of delivery, and in case the paper is not then obtained this office should be notified, so that the missing paper may be supplied. When a subscriber changes his address he ought to notify this office at once, so that the paper may be sent to the proper destination.

The paper may be obtained and subscriptions for it sent to the following agencies: Chicago, Post Office News Co., 217 Dearborn Street. London, Eng., Sampson Low, Marston & Co., Limited St. Dunstan's House, Fetter Lane, E. C.

The usual drop test for couplers is to drop a weight of 1,640 pounds three times upon the guard arm from a height of three feet and give subsequent drops of five feet until the failure occurs. This test, however, is not endorsed officially by the M. C. B. Association, although known as the M. C. B. test. More definite specifications are needed because of the influence of the rigidity or lack of it in the foundation, the amount of yielding of the lower ends of the vertical posts and the security and rigidity of the fastening of the coupler against lateral movement when the hammer strikes it. The weight, size and character of the foundation are equally important, and these factors vary greatly in the different drop-testing machines, and cause variety and unreliability in the results which must operate in an undesirable way as regards the attitude of manufacturers toward improvement. What is needed is an investigation of the subject by the association looking to placing the recommendations with regard to the construction of coupler drop-testing machines and the height and number of drops in the "Recommended Practice" of the association. In the discussion of a paper on "The M. C. B. Coupler," by Mr. Giroux, before the Western Railway Club, in March, Mr. Wm. Forsyth made such a suggestion in the form of a resolution which has the endorsement of the club. The idea deserves attention by the association.

Balanced valves have long been used in this country and with such satisfactory results as to cause wonder that they are not more extensively used elsewhere. Their high standing with American locomotive men probably resulted from tests made ten years ago, which showed that in a series of thirteen experiments the average resistance of a balanced valve was 330 pounds, against 905 pounds for the plain valve, the pressures and speeds being the same in both cases. The balanced valves required but 36.5 per cent. of the force expended upon the plain valves. These figures were published at the time and they have never been doubted, yet balanced valves have not been widely introduced in English practice. There is reason to believe that the balanced idea will soon take root there, however, as a result of tests recently made on valve friction by Mr. J. A. F. Aspinall, of the Lancashire & Yorkshire Railway, who compared plain valves with valves fitted with Richardson balance. He found that "there was considerable advantage in having to overcome a force of only 854.3 pounds for the balanced, as against 1946.2 pounds for the unbalanced valves." We do not believe in crowing about this too much, but Americans should see to it that there is no good thing in English locomotive practice that we do not adopt and if possible improve upon.

It has long been known that China has great natural resources only awaiting the introduction of adequate transportation facilities and capital in order to bring the country to the front among the productive nations, and the number of railroads projected shows that the value of transportation concessions has not been underestimated. In this issue we print an account of the work that has been done, the plans in process, a description of the wonderful resources of the country, and of the scramble after franchises which is now being carried on. This is the most complete article on the subject that has been printed. It is from the pen of the most accomplished engineer in China, who has been long in the field and speaks with authority. It is evident that concessions are difficult to obtain, on account of the bearing of political influences, both within and without China, coupled with the "peculiar" business methods in vogue there, and from the statements of our correspondent it is clear that Americans have not thus far met with encouraging success. Whether franchises are obtained by Americans or not, it is evident that our manufacturers of rolling stock and railroad supplies will find this field worth cultivating, and they should lose no time in securing a large share of the business which is sure to follow the projects already started. There can be no doubt that China is to have railroads, and many of them. Our methods and our unequalled facilities for promptly furnishing equipment and supplies give us every advantage in their development.

THE CLEANING OF TRIPLE VALVES

The Master Car Builders' committee having in hand the subject of "Trains Parting" has probably found that many factors tend to cause trains to break in two on the road and that with the increase in the number of air brakes and automatic couplers the trouble is likely to become more rather than less serious unless precautions hitherto thought unnecessary are looked after. One of these factors is believed to be the cleaning of triple valves. Since the publication of the record that was taken by Mr. Rhodes (printed in our issue of February, page 68 of the current volume), attention has been called by several motive power officers to the importance of insuring that triples are clean. In the article referred to the question was raised as to whether the time limit set by the Master Car Builders' Association of one year between cleanings was not unnecessarily long, but it is now thought that it is not too long, moreover additional evidence comes to light

showing that on some roads at least very few triples are cleaned that often.

In some records that were taken some time ago it was found that the triples of a comparatively large portion of the cars concerned, had not been inspected or cleaned but once in four years. This was not the worst of it either because the triples of these cars were found upon inspection to be in such bad condition as to be dangerous to run and they were known to have caused trains to break in two. It is becoming more and more important to keep brakes in uniformly good condition, not only that quick stops may be made when necessary but also—and this is hardly less important—that the brakes should be applied practically simultaneously throughout the length of the train. If the triple on a car in the middle of the train should lag behind those of neighboring cars a surge of the train is produced that may produce a break, and if several of them are slow in operation, trouble may be expected every time.

It is evident that this danger is not likely to grow less important with the increase in the number of air brake cars and the cleaning of the triples is apparently a matter of increasing importance. A great deal of thought is now given to the best method for handling trains that are partially equipped with air brakes and wide differences of opinion exist as to the best practice. There is reason to fear that very long trains with all the cars braked will not be much easier to handle than the partially equipped trains, and it is believed that the triple valve will need much more careful watching than it has had because of its influence in this form of accident. The air brake has done so much to advance the interests of railroads that the necessary care ought not in fairness to be given grudgingly.

MORE LIGHT ON THE COMPOUND LOCOMOTIVE.

Compound locomotives are making headway in this country, yet the progress is slow, especially as regards passenger service. As this type becomes better understood it will probably grow more rapidly into favor and anything in the form of practical scientific research into its efficiency compared with that of the simple engine is most valuable at this time, when many are studying the economical operation of locomotives so seriously. A paper recently read by Prof. R. A. Smart, of Purdue University, before the St. Louis Railway Club, gives information of this kind and the work appears to have been

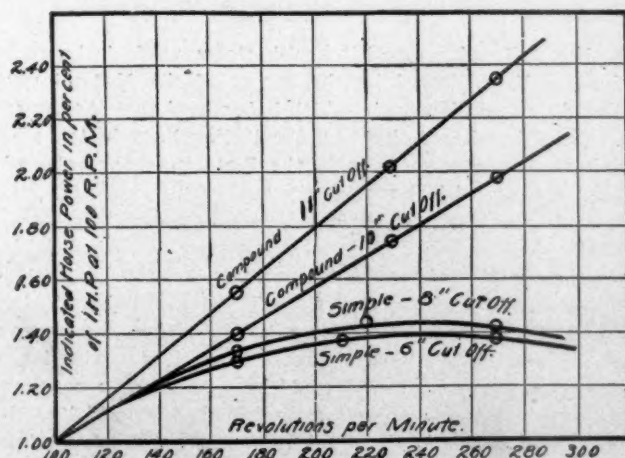


Fig. 1.

done in such a way as to entitle the results to confident acceptance.

The tests were made upon a Vauchain four cylinder compound, which is a part of the laboratory apparatus at Purdue. The purpose was to investigate the cylinder performance at high speeds and to determine in particular the change of power and steam consumption with change of speed. No data on the boiler performance were taken. Two series of tests

were made, one with 4.8 and the other with 4.2 expansions, the speeds ranging from 100 to 270 revolutions per minute, the boiler pressure being 140 pounds for the first series and 130 for the second. The ratio between the cylinders is 1 to 2.88.

Prof. Goss has shown by tests on the simple engine formerly a part of the laboratory equipment, that with the throttle fully open and the cut off constant the power increases as the speed up to a certain point, after which the power does not increase, even though the speed is increased. He has called that speed at which the power ceases to increase the "critical speed," and has shown that the steam consumption per horse power per hour is lowest when the engine is running at the critical speed, from which he

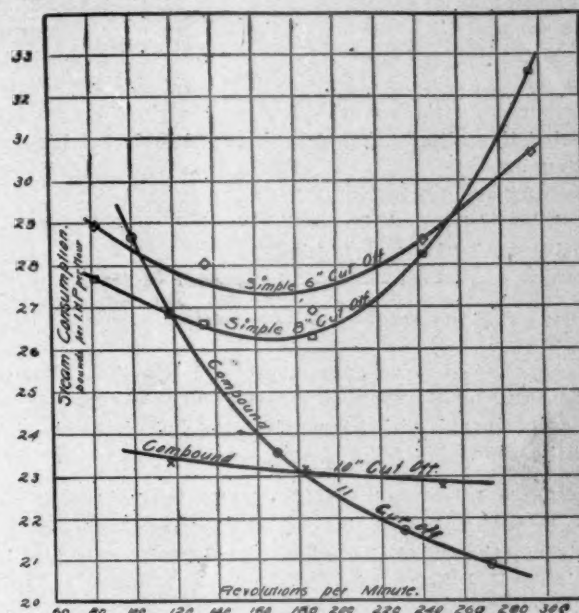


Fig. 2.

concluded that the critical speed is an important factor to be considered in the design of locomotives. This work is of special interest and importance when compared with the conclusion of Prof. Smart in regard to the compound, and instead of the power falling off above a certain speed it increased with the speeds up to the limit reached by the tests.

It has been generally admitted that the compound has the advantage over the simple engine in freight service when train loads become heavy enough to require a longer cut off than is economical in a simple engine, but it has also been generally believed that the compound works most favorably at slow speeds and with heavy loads. Compounds have been thought to lose both power and economy at high speeds and it has been urged that they could not be used indiscriminately in fast and slow service, which probably explains their greater progress in freight service. These tests throw much light upon this question and it appears that it has not been clearly understood.

The relation between the speed and the power of the compound compared with a simple engine is shown graphically in Fig. 1, reproduced from the paper, from which it appears that at 270 revolutions per minute there was not only an increase of power, but there was no evidence that the limit was even approached. The comparison in the economy of the two types as affected by the speed is seen in Fig. 2, and it is important to note that in this comparison the compound was run at a cut off corresponding to freight service, while the simple engine was worked at shorter cut offs. Prof. Smart suggests the probability that if the simple engine had been worked harder the curves of compound would have been at all points below those of the simple engine, which tends to form the basis for a conclusion favorable to the superior economy of the compound under all conditions of running.

Prof. Smart found that the change in the steam distribution in this type of four-cylinder compound gave increased horse power and economy up to 270 revolutions per minute, the limit reached in the tests, and the tendency of the curves indicated that the increase in power would continue for much higher speeds. In this he is supported by data obtained in other tests made on this same type of compound. The increase in power with the speed was due to the steam distribution and the increase in economy was attributed to a decrease in the cylinder condensation, as shown by the quality of the steam at release in the low pressure cylinder. The average steam consumption by the compound was much lower than the lowest consumption by the simple engine, and under exactly comparable conditions probably the compound would show lower consumption of steam at all speeds and points of cut off. It is interesting to see that the economy of the compound was improving at the upper limit of speed, the curves not having reached the minimum points, and this, together with the fact that the power curves of the compound were straight lines, makes it clear that these limits should be exceeded in future tests upon the same lines.

The tests are conclusive as far as they go, but the importance of the subject and the possibilities indicated demand more extensive work of the same kind.

NOTES.

Fireboxes of nickel steel are to be tried in the locomotives on the Prussian Government lines. The thickness will be 7 mm. as compared with copper 16 mm., but the cost will be about the same. Staybolts of nickel steel are also to be tried.

The Santa Fe offered a prize of \$150 to the freight agent on its line who showed the greatest increase in business for the six months ended December 1, 1897, and it has just been awarded to F. J. Gates, who represents the company at Gainesville, Tex.

It cannot be gratifying to engineers in this country, says "Transport," an English contemporary, to be reminded that, when the Russian Government had in contemplation the construction of ice crushing steamers for the trans-Siberian route, a number of experts were sent to the United States to examine and report upon the lake vessels!

The largest tank steamer in the world is nearly ready for launching at the Roach shipyard, Chester, Pa. She is for the Standard Oil Co., and has a capacity of 720,000 gallons of oil. The cost will be \$250,000. The length over all is 254 feet, beam 40 feet, engines 1,500 horse-power and speed 12 knots per hour. The oil tanks are separated from the engine and boiler spaces by wells filled with water for safety against fire. She may use oil for fuel, although this has not been decided.

The qualification of steel for making coupling links was discussed recently before the Western Railroad Club. Mr. I. C. Hubbell, Purchasing Agent Kansas City, Pittsburgh & Gulf, after about a year's use of steel links gave a very satisfactory report of their service on that road. None of the links broke in the weld. Mr. Wm. Forsyth said that he had found steel links to more than meet the specifications required and if of good material and properly welded he preferred them to iron links.

Writing about the utilization of exhaust steam in "The Engineering Magazine," Mr. Bryan Donkin says: "To allow the exhaust steam to escape uncondensed is a disgrace to engineers." Much has been done to save coal, and it is sometimes forgotten that there is the most direct possible relation between coal and steam and hot water. There are many places where the result of installing supply tanks, condensers, circulating and air pumps, and counting also the additional cost of operating the pumps, will be a net gain which will pay for the equipment even in the first year.

Purdue University has a new building in the process of erection which will constitute an addition to the present engineering laboratory. The new portion is 50x100 ft. in size, is located between the steam engineering laboratory and the locomotive laboratory, and is to be connected by passage ways with both of these buildings. The addition is to be known as the railway laboratory, and is the last of the series of engineering laboratories which were provided for in the original plan of the present group. The Purdue engineering laboratory now includes seven large laboratory rooms: A wood-working room, foundry, forge room, machine room, steam engineering laboratory, locomotive laboratory, and railway laboratory.

An undulating grade line, with summits at stations, for service requiring frequent stops has often been suggested and is sometimes ridiculed. An example of this will be seen in practice on the Central London Railway, recently described in "Engineering." Starting out of Oxford Circus there is a level portion of 160 feet, 295 feet of 1 in 30 down; 925 feet of 1 in 622 down; 595 feet of 1 in 60 up, and 160 feet level. At starting the motors exert a draw bar pull of 9,600 pounds for 18 seconds until the 160 feet of level is passed and the down grade is entered, when the acceleration is increased and the drawbar pull reduced to 3,200 pounds. The speed 58 seconds after starting is 24.5 miles per hour, and in 755 feet it must come to rest, 34 seconds being allowed for this.

The depression of rails under heavy locomotives and the increased fibre stress in the rails caused by the neglect of apparently small precautions was very well illustrated by Mr. F. A. Delano in a recent paper before the Western Railway Club. He showed that merely changing from gravel to cinder ballast, and increasing the weight of a locomotive 15,000 pounds increases the strain on the base of the rail from 10,450 pounds to 13,810 pounds, a difference of 3,360, or an increase of 32 per cent. The removal of a tie from a track laid with a 66-pound rail supported on oak ties and gravel ballast increases the strains produced by an engine weighing 125,000 pounds from 13,810 pounds to 16,430 pounds, an increase of 2,620 pounds, or 19 per cent. This shows the evils of removing a tie for drainage purposes, which is a practice not uncommon with track men. It seems a small thing to remove only one tie, but in the light of these figures it is really a serious menace to the life of the rail from which it is removed.

Trolley railroad competition with steam roads is becoming serious, as is indicated by the report of the Massachusetts Railroad Commissioners, in which it is stated that if the present rate of building is kept up the trolley lines in ten years will have a greater mileage in the State than the railroads. There were carried last year on the street railways of the State in round numbers 308,700,000 passengers—an increase of 16,300,000 for the year. This was, however, a marked falling off in the rapidity of growth of traffic as compared with 1896, when the increase of passengers was in round numbers 32,600,000, and still more as compared with 1895, when the increase was 39,300,000. The average increase since the introduction of electric motive power (in 1889) had been 20,600,000 a year, and for the five years next preceding the last, had been 23,300,000 a year. The decrease in the number of passengers to and from Boston on the four leading suburban lines of steam railroad for the four years from 1893 to 1897 was 12 per cent. for all the companies, one road having lost 22 per cent. The corresponding gain in traffic on five competing trolley lines for the same period was 31 per cent., and one of these lines showed a gain of 155 per cent. in that time. The transfer of the business is not attributed to any neglect on the part of the management of the steam roads. It is the result of well understood changes in the conditions of such transportation which the steam roads are unable to control.

THE HOLLAND SUBMARINE BOAT.

Great interest is now centered in the submarine torpedo boat recently built by Lewis Nixon for the John P. Holland Torpedo Boat Company, and now undergoing trials in the vicinity of New York. Mr. Holland has been working on this problem for about 20 years, and this boat is the sixth built by him. This one is 53 feet long, 10 feet 3 inches diameter, and has a displacement of 75 tons. Another is now building in Baltimore, the dimensions of which are 85 feet long by 11½ feet diameter and 168 tons displacement. The hull is shaped like a cigar, with a peculiar superstructure flat on top.

The hull is of steel plates, riveted to a steel skeleton frame. Amidship is a conning tower, 2 feet in diameter, so made as to extend from two to three feet high, or telescope flush with the hull. Within the hull, immediately below the conning tower, are the two tillers, one for surface sailing, the other to regulate the depth at which the boat is operated when submerged, and the speaking tubes, electric bells, and a table connected with apparatus for manipulating a camera lucida, used

by compressed air, which also maintains the air pressure throughout the boat to equalize the pressure of the sea when the boat is submerged. The boat is quickly submerged by admitting sea water to a series of steel tanks connected with the compressed air system. When the commander signals to elevate the boat from the depths, air is forced into the water tanks under high pressure, and as the water is expelled the boat rises swiftly to the surface. The air tanks have been tested to stand a pressure of 3,000 pounds to the square inch, and are calculated to hold out for a submergence lasting ten hours, but if the supply should fail after nine or ten hours the tanks can be replenished by means of a tube projected to the surface as a suction pipe.

The armament of the boat consists of one dynamite gun, one automobile torpedo tube, and one aerial torpedo tube. These tubes and gun are made effective by the use of compressed air, which not only enables the torpedo and gun operators to hurl torpedoes and great masses of dynamite with precision and force, but immediately restores to the boat the weight of 800 to 1,000 pounds lost when a projectile or mass of dynamite



The Holland Submarine Boat.

when the boat is submerged for portraying the appearance of the surface. The view is secured by means of a steel tube thrust above the water and fitted with camera apparatus. There are three sources of energy for propelling the boat above and below the water, expelling water, discharging torpedoes and dynamite guns, and lighting the ship internally and externally; these sources are compressed air, gasoline and electricity.

The important agent is compressed air, without which it would be impossible to operate the boat under the sea. The air compressor was built by the Ingersoll-Sergeant Drill Co. It is of the single acting type, belt driven from a gasoline engine, when the boat is on the surface, and from an electric motor switched to a storage battery, when the boat is submerged. The compressor is capable of compressing air to 2,500 pounds pressure; the diameter of the low pressure cylinder is 6 inches, the high pressure cylinder is 1¼-inch diameter, with 8-inch stroke. Both cylinders are immersed in a water box, which cools the air during compression. Solid discs serve for fly wheels. The space occupied is only six feet five inches long, by two feet high. The most important use of the compressed air is for the respiration of the crew, numbering ten men. For this purpose the air is expanded through two reducing and one regulating valve, and is set free at the normal atmospheric pressure.

Six times the requisite volume of air is available; the surplus air is used for counteracting the deleterious effects of the ventilating pumps, which would produce a near approach to a vacuum, if the air supply from the tanks was interrupted in its even flow. The steering and driving gear are operated

by compressed air. The muzzle energy of the dynamite gun is 750 tons.

The trials show a speed of 10 knots, with the conning tower flush with the surface, and under water speeds of 6 knots have been made for distances up to a mile, the depth of submergence being about 15 feet.

The performances of this boat are very promising, those of the projectiles not less so than the working of the boat itself. We acknowledge the courtesy of the Ingersoll-Sergeant Drill Company for the engraving.

MONITORS VS. BATTLESHIPS.

The preference for the monitor type of war vessel is very strong among those who have fought in them and now contemplate the high free board and large target areas offered by modern battleships. In a recent address, Lieutenant Moses S. Stuyvesant expressed an opinion of the monitor in the following terms, which is well worth quoting:

"What is the matter with the monitor, that those who design our ships and who do not go to sea in them must have battleships? The two-turreted monitor is a fighting ship par et simple, stripped to the waist, and has no solar plexus. She does not require a man of cast steel to get out of her all she is capable of. Her main deck is only 12 to 16 inches above water, presenting an armored target that high, and about 270 feet long. On top of this are two low turrets, containing each two heavy rifles. On top of them is a light superstructure, in which are a few light guns for repelling boarders, torpedo boats, etc. With equal guns she can whip any battleship afloat."

American Society of Mechanical Engineers.—The next meeting of this society will be held at Niagara Falls, N. Y., May 31 to June 3.

TRIAL CONSOLIDATION LOCOMOTIVE—C., C. & ST. L. RY.

A new single expansion freight locomotive has just been delivered to the C., C. & St. L. Ry. by the Richmond Locomotive Works, and is now in service giving excellent results which lead to the expectation that more will be built from the same drawings and specifications. The illustrations show the chief features of the design, which may be enumerated as follows:

The engine has 20 by 26-inch cylinders, 51-inch drivers, an extended wagon top, radial stayed boiler, long main and eccentric rods (the eccentric rods are I section), a long deck in the cab, and large coal and water carrying capacity. The firebox is above the frames. The engine weighs 150,500 pounds, with 134,650 pounds on drivers, and was designed with the expectation of hauling one-third more tonnage per train than was handled by the heaviest freight engines in use on the road previously. The records show that the new one hauls trains of 1,500 tons as compared with 1,050 tons for the other, these trains being hauled up grades of 45 feet per mile, the weights being taken for the train and caboose only. The fuel performance is 0.09 pound of coal per ton mile, as shown by the records of the road. The heating surface of the boiler is 2,431 square feet, and the grate area 35.23 square feet, giving a ratio of 69 to 1 between the heating surface and the grate area.

The engine has the Leach track sander, Monitor injectors, Janney couplers on both ends, Westinghouse air brakes and springs by the A. French Spring Co.

The general dimensions are given in the following table:

Gauge	4 feet 8½ inches
Kind of fuel to be used.....	Bituminous coal
Weight on drivers	134,650 pounds
" truck wheels	15,850 pounds
" total	150,500 pounds

General Dimensions.

Wheel base, total, of engine.....	23 feet 8½ inches
" driving	16 feet 0 inches
" total (engine and tender).....	51 feet 5¼ inches
Length over all, engine.....	42 feet 2 inches
Height, center of boiler above rails.....	8 feet 1¼ inches
of stack	14 feet 8 inches
Heating surface, firebox	171.05 square feet
" tubes	2,260.00 square feet
" total	2,431.05 square feet
Grate area	35.23 square feet

Wheels and Journals.

Drivers, number	8
" diameter	51
" material of centers	Cast steel
Truck wheels, diameter	30 inches
Journals, driving axle, size	8¼ by 11 inches
" truck	5¼ by 10 inches
Main crank pin, size	6 by 6½ inches

Cylinders.

Cylinders, diameter	20 inches
Piston, stroke	26 inches
rod, diameter	3¼ inches
Main rod, length, center to center.....	10 feet 1¼ inches
Steam ports, length	20 inches
width	1¼ inches
Exhaust ports, length	20 inches
width	2¼ inches
Bridge, width	1¼ inches

Valves.

Valves, kind of	Richardson balanced
" greatest travel	5½ inches
" outside lap.....	¾ inch
" inside lap or clearance.....	0 inches

Boiler.

Boiler, type of	Extended wagon top
" working steam pressure	190 pounds
" material in barrel	Carbon steel
" thickness of material in barrel.....	9-16, ¾ and 1-16 inches
" diameter of barrel	64 inches
Thickness of tube sheets.....	¾ and 9-16 inch
crown sheet	¾ inch
Crown sheet stayed with.....	Radial stays
Dome, diameter	30 inches

Firebox.

Firebox, length	9 feet 6 inches
" width	3 feet 5¼ inches
" depth front	72 3-16 inches
" back	69 3-16 inches
" material	Carbon steel
" thickness of sheets	¾ inch
" No brick arch	
" water space, width—	
Front, 4 inches; sides, 3¼ inches; back, 4 inches	

Grate, kind ofRocking and drop

Tubes, number	330
" material	Charcoal iron
" outside diameter	2 inches
" length over sheets	13 feet 6 inches
Smokebox, diameter	67 inches
" length	67 inches
Swivel trucks	
Tank capacity for water	4,500 gallons
Coal capacity	12 tons
Type of under frame	Wood
Truck bolster	Rigid
Type of truck springs	Elliptic
Diameter of truck wheels	36 inches
Diameter and length of journals	5 by 9 inches

Personals

Mr. Sheldon T. Bent has resigned as Superintendent of the Interoceanic railway of Mexico.

Mr. J. Kruttschnitt has been elected Fourth Vice-President of the Southern Pacific, a newly created office.

Mr. H. Walter Webb, Third Vice-President of the New York Central & Hudson River, has resigned on account of poor health.

Mr. J. G. Justice has been appointed Master Mechanic of the Plant System, at Waycross, Ga., succeeding Mr. D. B. Overton, resigned.

Mr. J. G. Thomas has been appointed Division Master Mechanic of the Lehigh & Susquehanna Division of the Central of New Jersey.

Mr. Frank Slater has been appointed Master Mechanic of the Chicago & Northwestern at Escanaba, Mich., vice Mr. J. W. Clark, resigned.

Mr. W. L. Hoffecker has been appointed Division Master Mechanic of the New Jersey Central Division of the Central Railroad of New Jersey.

Mr. Percival Roberts, President of the A. & P. Roberts Co., proprietors of the Pencoyd Iron Works, died at his home in Philadelphia March 30.

Mr. Raymond Du Puy has been appointed General Superintendent of the Chicago Great Western, succeeding Mr. Cornelius Shields, resigned.

Walter Dawson, formerly for many years Master Mechanic of the Delaware, Lackawanna & Western, died in New York, April 12, at the age of 75 years.

Mr. Frank W. Edmunds, for many years General Sales Agent of the Troy Steel Company, has been appointed Secretary of the I. & C. Co., of Chicago.

Mr. W. C. Hofman has been appointed Master Mechanic of the Chicago & Southwestern, with headquarters at Lebanon, Ind., succeeding Mr. J. W. Roberts.

Mr. W. F. Beardsley, Master Mechanic of the shops of the Pennsylvania lines at Allegheny, Pa., has had his jurisdiction extended over the Erie & Ashtabula Division.

Mr. J. Van Dell, formerly with the Chicago & Alton, has been appointed Master Car Builder of the Chicago, Rock Island & Pacific, to succeed Mr. L. T. Canfield, resigned.

Mr. C. H. Beggs, Secretary to the Vice-President and General Manager of the St. Louis & San Francisco, has also been appointed Purchasing Agent, with office at St. Louis.

Mr. W. H. Newman, Second Vice-President of the Great Northern, has been selected for the Presidency of the Lake Shore & Michigan Southern, to succeed Mr. Callaway.

Mr. George Tozzer, who has been Assistant Purchasing Agent of the Cleveland, Cincinnati, Chicago & St. Louis, has been appointed to succeed the late Mr. A. M. Stinson as Purchasing Agent.

Mr. Charles A. Van Keuren, formerly Superintendent of maintenance of way of the West Shore railroad, has been appointed Chief Engineer of the street and water board of Jersey City, N. J.

Mr. J. W. Harkom has resigned as Master Mechanic of the Eastern Division of the Grand Trunk at Montreal to accept the position of Assistant Mechanical Superintendent of the Canadian Pacific.

Mr. Charles P. Coleman, General Storekeeper of the Lehigh Valley, with office at Packertown, Pa., has resigned to accept the position of Purchasing Agent of the Bethlehem Iron Company, South Bethlehem, Pa.

Mr. H. S. Stebbins, General Manager of the Bath & Hammondsport, and the Lake Keuka Navigation Co., has resigned and his duties will be assumed by Mr. C. W. Drake, President of both companies. Mr. Charles J. Drake has been appointed Superintendent.

Mr. Chauncey M. Depew has retired from the Presidency of the New York Central & Hudson River to take the Chairmanship of the Boards of Directors of the Vanderbilt lines, comprising the New York Central & Hudson River, the Lake Shore & Michigan Southern, the New York, Chicago & St. Louis and the Michigan Central.

Mr. W. G. Collins, who for the past seven years has held the position of General Superintendent of the Chicago, Milwaukee & St. Paul, has been appointed General Manager, and will relieve Mr. A. J. Earling of the duties of that office. Mr. Earling has been Second Vice-President and General Manager since 1895, and was appointed General Manager in 1890.

Mr. S. R. Callaway, President of the Lake Shore & Michigan Southern, has been elected President of the New York Central & Hudson River, to succeed Mr. Chauncey M. Depew. Mr. Callaway began his railroad career in 1863 as clerk in the Auditor's office of the Grand Trunk, and his rise has been steady to his present high position. He succeeded the late Mr. D. W. Caldwell as President of the Lake Shore last Summer.

Mr. William G. Creamer, who was well known to our readers as a valued contributor, died at his home in Brooklyn, April 22, at the age of 73 years. He was a pioneer in the development of the air brake giving control of the train brakes to the engineman, which work he was engaged upon in 1856. He is also widely known on account of his attention to the subject of passenger car ventilation. He leaves a widow and one daughter.

NEW INGERSOLL-SERGEANT AIR COMPRESSORS.

Fig. 1 shows the type of air compressors recently introduced by the Ingersoll-Sergeant Drill Co., known as Class "H," which is furnished either in half duplex for the future addition of the second half or in the duplex form. It is built with both steam cylinders non-compound or is arranged as a cross-compound, and with air cylinders either compound or non-compound. In duplex compound the usual capacities are 80, 210, 346 and 519 cubic feet of free air per minute. It is a very compact type, being designed to occupy a very small space.

The duplex construction, generally used where the demand for air fluctuates, offers a marked advantage in regulation. The machines have ball governors to prevent excessive speed

in case of air pipes bursting, and in combination with this is a throttling regulator, causing the machine to work at the speed which is necessitated by the demand. The duplex machine is slightly more economical than the straight line, because of the heavier fly wheel and also because of the greater advantage which may be taken of expansive working; also the high pressure side may be used alone if the low pressure side is disabled.

Compounding on the air side is advocated because of the reduction in the loss through heating the air in single expansion. Besides the losses excessive heat makes lubrication difficult. In this machine the air in passing from the low to the high pressure cylinder comes in contact with cooling surfaces in an inter-cooler, the saving from which may be expressed as from 15 to 20 per cent. of the power required in compressing.

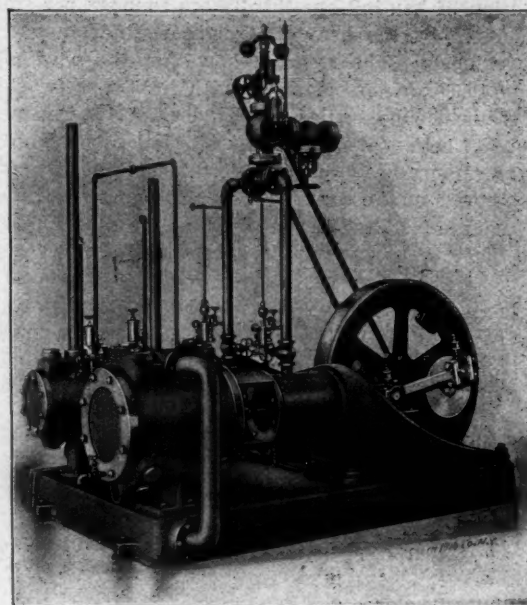


Fig. 1 Class "H" Compressor.

The wearing of the parts is improved by the use of this plan, because of the ease of lubrication and the reduction of the maximum stresses.

In a duplex compressor the maximum stresses from the steam and air cylinders are what may be termed cross stresses, which require rigidity in the fastenings of the cylinders in order to keep the machine in line and to avoid high internal friction. The sole plate of this machine is exceedingly rigid and is in itself a foundation for the machine, not requiring an expensive substructure, a few mud sills being a sufficient support. The sole plate in this type of compressor is utilized as an inter-cooler, the interior construction of which resembles that of a surface condenser, in which the cooling surface consists of a large number of tubes through which water circulates. The cooler is so constructed that it may be removed and entirely exposed for cleaning in a few minutes.

The air cylinders have ample intake passages, the valves are light in weight and are so made that in case of a broken stem they cannot be drawn into the air cylinder. Provisions are made for drawing the air from out of doors. The inlet valves are placed under the cylinders where they have ample lubrication. The clearance spaces are very small and the air passages are so arranged that the incoming air is not brought into contact with hot metallic surfaces. Deep stuffing boxes are used, completely water jacketed, adapted to the use of loose packing. The air cylinders are completely water jacketed, including the heads, this being possible on account of the location of the inlet valves under the cylinders.

The steam cylinders of all sizes are covered with sheet metal,

carefully packed with non-conducting material. In all sizes smaller than 12 by 12 inches a special economical light running slide valve is used, located so that the exhaust constantly drains the cylinder. The ports are large and short. In sizes

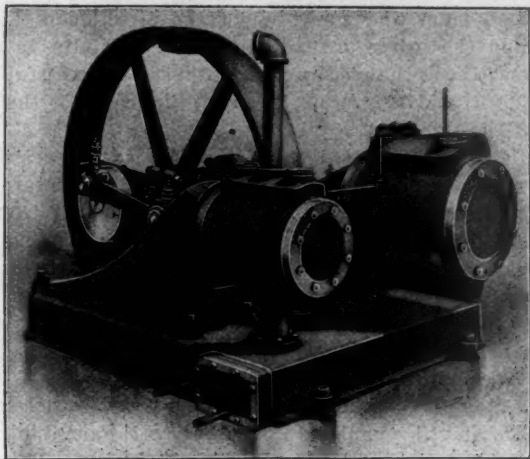


Fig. 2.—Class "J" Compressor.

12 inches or larger, the Meyer expansion valve gear is used, allowing early cut-offs without compression.

The bearings are babitted and made adjustable for wear and are of large diameter. The fly wheel is made in halves, and is very heavy. A great deal of metal is put into the ma-

In Fig. 2 a duplex belt compressor, known as Class "J" is illustrated. It is furnished in capacities corresponding with the Class "H" machine, and the description already given will make its construction clear. The sole plate is shortened and the air cylinders are bolted to the Tangye bed plate, instead of to the steam cylinders, while the fly wheel is displaced by a belt pulley. Owing to the stresses due to the four discharges of air per revolution in a duplex machine the belt pull is much steadier than in a single machine, and as the terminal strains are greatly reduced by compounding, the duplex compound type gives the best results, owing to the nearly uniform belt pull.

The regulation of a belt machine, the speed of which must be constant, is an important matter, and in this machine the Sergeant unloading device is used, which regulates the work by drawing back a sufficient number of the discharge valves at each end of the air cylinder, giving a by-pass for a portion of the air. Upon the fall of the pressure the load comes back gradually and we are informed that the regulation is entirely satisfactory. This compressor is entirely automatic in its action and has an inter-cooler.

In Fig. 3 a view of a Class "C" Corliss compressor is shown, having 24½ by 42 inch air cylinders, the photograph being taken from a compressor now working at the Aurora mine, Ironwood, Mich.

PHILADELPHIA & READING RAILWAY—SHOP NOTES.

The principal shop plants of this road are at Reading, Pa. The rolling stock repairs, excepting those made at the division roundhouses, are all done at Reading. The road has 19 roundhouses, some of which were formerly used also as the

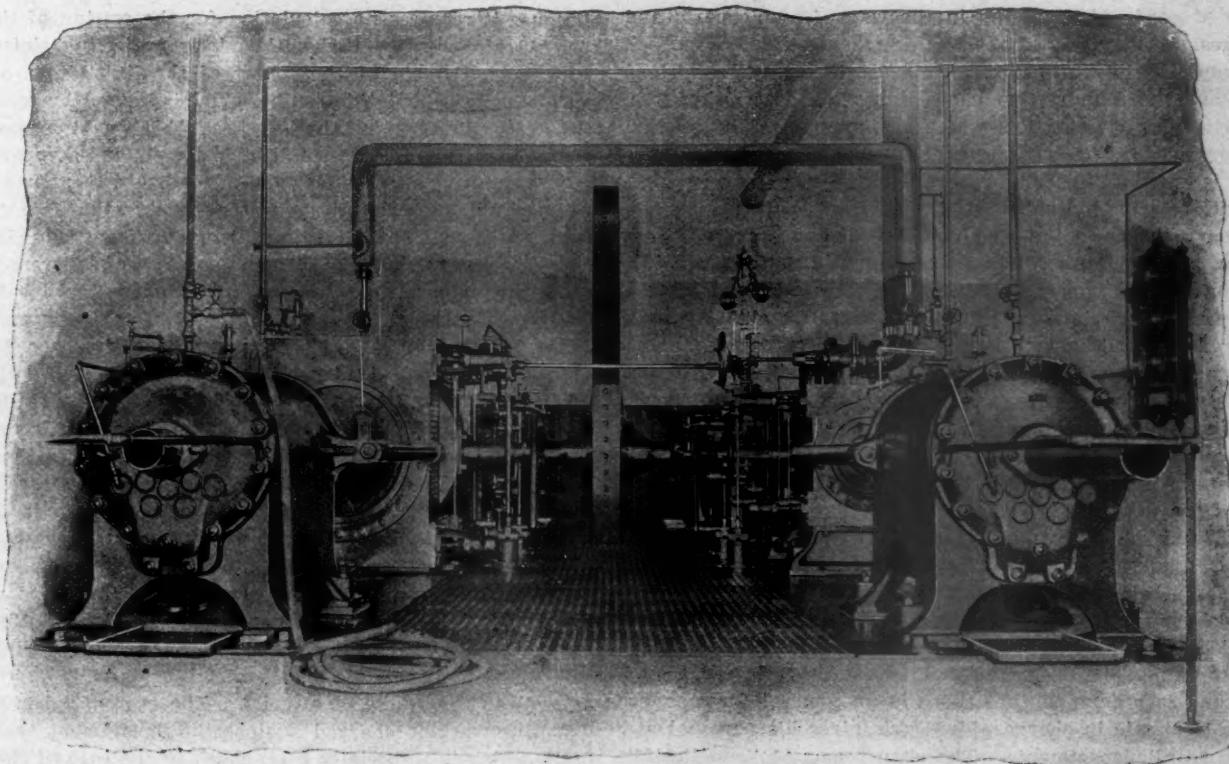


Fig 3.—Class "C," Compound.

chines, making them rigid and strong, with little liability of getting out of line. The type was designed especially for manufacturing, railroad shop and mining requirements. This is a very recent design and represents the best development by this firm for the service intended.

repair shops of the roads which now form the Reading system, and these old shop equipments are now utilized to relieve the pressure of work at the Reading shops. The largest of these roundhouse plants have drop pits, and facilities for giving general repairs to about eight engines per month, and in case

of accident at the main shops the roundhouse plants could be used to very good advantage.

Eight hundred and fourteen locomotives are maintained at Reading, the number of men at present employed there being 950. The capacity of the shops and the two largest roundhouses is 45 engines per month for general repairs. At Reading 52½ hours per week are now made, and 56 engines are in the shop. These are practically all in the immense erecting shop, which is about 180 by 375 feet in size.

Locomotive Shops.—The Reading locomotive shops cover a large area, and are divided by a street and by the main tracks into three parts—offering a tempting layout for a system of electric distribution of power. Liberal use of Westinghouse engines is made in the forge and boiler shops, which have great advantages over long lines of shafting. All of the shops are roomy, and most of them are very well lighted, and generous floor space is provided, a very unusual thing even in the most recent plants. The floors are clear of material, and it is a matter for wonder where all of the material and the parts undergoing repairs are put. They are not allowed to litter up gangways and floors and are replaced on the engines at the earliest possible opportunity. Mr. Davis believes in clean, orderly, systematic work, and the attention he gives these matters evidently pays. The shops and roundhouses are white washed twice a year, and efforts are made to make the surroundings of the men attractive.

The most recent purchases of tools show a disposition to secure large capacity. Among these a large Acme bolt-header was seen in the forge shop, and a No. 5 combined punch and shear by Hilles & Jones in the boiler shop. A new Ingersoll-Sergeant air compressor has been set up in the engine room of the boiler shop and foundry, and for the four cupolas an old fashioned upright blowing engine and two rotary blowers are used. The chief interest in the blowing engine is the example of good old designing in the way of ample ports and passages.

It would be interesting to go into details as to the various shops and the foundry, but space limits the description to a few principles of operation, which are being carefully studied and practiced. The maximum output for the minimum expense is sought after and many machines are now running without exclusive individual attention. The man who runs the stationary engine in the erecting shop also runs a drill press nearby, and the same idea is carried out in various parts of the works. The concentration of all of the work of certain kinds for the whole system in these shops is good business management, and it is evident that the parts of the plant given to such departments are the busiest of all, which looks like getting good returns for investment. The brass work, including finishing and plating, are examples of this. In the plating department a simple machine for polishing the reflectors of headlights after they are silver plated is working without any attention whatever. A very hard, steel burnisher is held by a rod suspended by a spring from the ceiling, and is given a vibratory motion by a crank and connecting rod driven by a belt. The reflector is held in a socket and slowly rotated by a worm gear, while the burnisher polishes the surface with a lubricant of soap and water. It runs all day without attention. The organization in these shops is very complete, and is unique in that there is no general foreman or Master Mechanic in charge. Mr. Davis gives his personal attention to all departments. The shop seems to "run itself," and the object in view was to arrange and plan the work so carefully as to permit of competition with manufacturers in all classes of work done.

Piece Work.—About 40 per cent. of all the locomotive repair work is done on the piece work plan, it is also used in erecting work, but to a smaller extent. Great care is given to the establishment of the piece work prices, and the system is satisfactory alike to the men and the officers. A feature of the system, new to us, is to put the finishing of certain parts under the piece work system, while the preparatory operations are

done by day work, the effect of which is to cause the piece workers to urge the day workers to furnish material promptly in order that the advantages of the piece rates may be obtained. The plan operates admirably, its effect being to improve the day work to correspond with the piece work, the urging being done by the men themselves rather than by the foremen. In fixing the piece work prices the work is given to a good man, who works under the direction of the foreman, and the prices are established so carefully as to lead the men to seek the piece work. It must be successful for the men like it, and the output is greatly increased to the advantage of the company.

Appliances.—The tool room for the large erecting shop is admirably supplied with gages, among which are trams and gages for setting shoes and wedges. Long T iron gages are used for setting the shoes, and a corresponding set of trams is used for rod work, the object being to save the trouble of trying the rods in fitting them up. After the frames are in place the main shoes are made square and the other shoes are set by the long gages, after which the wedges are marked from the shoes by means of short gages. The rod work is done in another shop, and the rods are not tried on the wheels until completed. Another tool room kink is the system of taps for wash-out plugs in the boilers. There were over a hundred different sizes of plugs in use before a plan was put into use requiring only 12. Each tap is divided by horizontal lines about one inch apart, and each section of the tap has a number stamped thereon, which exactly corresponds to a mud plug having the same number. The man who taps out a mud plug hole notes the number on the part of the tap that fits the hole, and calls for a plug bearing that number, which is sure to fit. Time as well as stock is saved by this simple improvement.

A link grinder operating in the machine shop is interesting because it requires no calculation for the setting of the link. An old planer was fitted with a long projecting slotted arm to receive the pin at the center of the link circle, and the link vibrates about this center, which is formed by measuring the link radius back of the link arc. This machine was working unattended. It cannot fail to do correct and accurate work.

Arrangement of Machinery.—The tendency to group all tools of one kind, such as lathes and planers, together is noticeable in many shops, but at Reading the arrangement is made solely to suit the work, and to save the services of laborers in carrying the material about. By a few changes in tool locations 30 laborers have been dispensed with, and a plan very much like those followed by manufacturing concerns has been adopted.

In the rod work, benches, two shapers, one bolt lathe, one boring mill, one drill press, one planer and a hydraulic press are provided, all in the same room, are conveniently arranged for handling the work by overhead travelers, and the entire rod job is conducted with no transferring whatever. Car brasses were formerly taken from the brass foundry (about two blocks) to the machine shop for boring, they were carried back to the foundry for lining and back again over the same route to the storehouse upon completion. By putting the machine close to the foundry the cost for labor in finishing was reduced 50 per cent. Accounts are kept for each department, making it possible to tell what it costs to do any portion as well as the whole of any job. The cost of labor lost on defective work is charged against the department that is at fault, which is a specially good check in the case of the foundry. The changes in locations of tools apply to about 25 per cent. of the machine tools at Reading, and the work is cheapened as well as accelerated thereby.

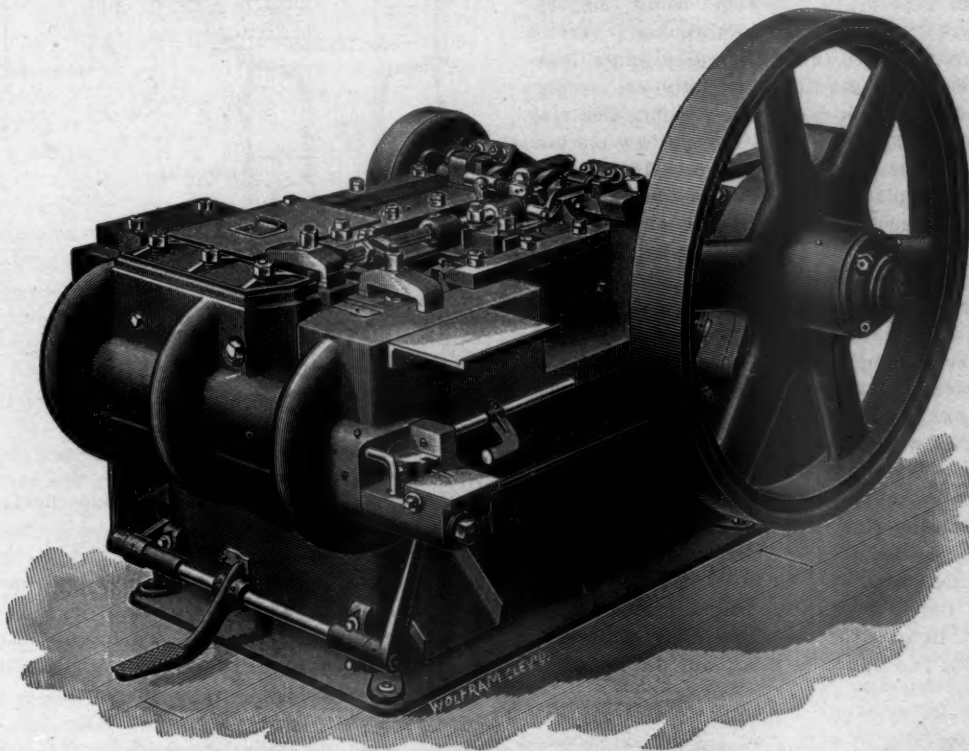
Standardizing Locomotive Parts.—A systematic effort to standardize parts of the locomotives has resulted already in a saving of \$50,000 in the amount of material carried in stock at Reading, and this is one of the greatest improvements that is being made, and is next in importance to the saving of fuel. The most important of the improvements may be noted as follows: Of 19 shops no two used the same taps for water

bars and washout plugs; 16 different styles and sizes of cylinder cocks were changed to one standard; 24 number-plates changed to one; 98 lengths of engine feed hose changed to one (there were sometimes three different lengths of hose on the same engine); 20 tender brake shoe patterns were discarded for one; 11 blow-off cocks gave place to one; 144 sizes of mud plugs were reduced to twelve; the spring list was reduced 50 per cent., with a prospect of cutting the remainder in two; over 100 different eccentrics and straps were reduced to three; 12 styles of engine truck brasses and boxes are reduced to one style and two sizes, 5 by 8 and 6 by 8 inches; 21 different exhaust pipes used on a single class, numbering 64 engines, represent the condition as to these parts, this class and five others are now provided for by a single standard pipe, and three pipes answer for all wide firebox engines.

THE ACME HEADING AND FORGING MACHINE.

This machine, built by the Acme Machinery Co., of Cleveland, Ohio, has an exceedingly strong and heavy bed, made in the form of a box, with three deep trusses extending longitudinally, which are braced by a truss extending across the machine transversely, besides which the fly wheel bearing is reinforced with a steel beam.

The shaft, which is iron, has a clutch hub and two double disk cranks forged in one piece, and is carried in three large bearings, the faces of which are inclined at an angle of 45 degrees toward the front of the machine, which is done to bring the thrust of the forging tools directly against solid metal instead of against the caps. A tool steel pin is fitted in a mortise of the clutch hub, it engages with a cushion clutch



Acme Heading and Forging Machine.

Many other roads ought to take up this subject as systematically as the Reading has done.

Fuel Saving.—The importance of saving coal, even in a section where its cost is relatively low, is fully appreciated, and efforts are made to use the fuel to the best advantage. The consumption of fuel on the road is being studied and one of the efforts to reduce unnecessary waste is explained in the following explicit circular, which Mr. Davis kindly allows us to print:

To All Men in Charge of and Handling Locomotives:

The practice of running the air pump when unnecessary and allowing steam to escape through the safety valve must be avoided as much as possible. Special care must be taken while waiting at a station, on a side track, or at the engine house.

Example.—The amount of fuel and water consumed per hour for running a 9½-inch pump is 70 pounds of coal and 60 gallons of water; equivalent to 4 cents. The amount of fuel and water consumed per hour for a safety valve blowing is 870 pounds of coal and 750 gallons of water; equivalent to 45 cents.

If each engine is allowed to waste fuel one hour per day, which is about the average, 700 engines will consume per month, 9,870 tons of coal and 17,010,000 gallons of water, at a cost of about \$10,300.

The responsibility of this waste rests wholly on the men handling the engine.

E. E. DAVIS.

Assistant Superintendent of Motive Power.

stop motion controlled by a foot treadle and is automatically released when the treadle is raised. The object of this is to permit of giving any desired number of blows and by throwing in the treadle latch the machine will work continuously.

The fly wheel has a bronze bushing, which gives good wearing and smooth running qualities, and permits of rapid repairing. The slides have ways of phosphor bronze, side gibs of cast iron, running on hardened tool steel ways in the bed, and all these parts may be easily and quickly renewed when they become worn. Cast steel is used for the stationary and movable die blocks as well as the toggle block, while the toggles are of forged steel and hardened. These parts are all given ample bearings and they rest on steel ways after the manner of the main slides. The arrangement is such that no reciprocating parts wear on the bed. The machine has an outside shear that will shear cold stock to a diameter of one-half the rated capacity of the machine, and when the stock is hot it will shear to three-fourths of the rated capacity.

The machine is provided with an automatic relief and adjustable time device, consisting of a spring in the slide that moves the links, which in turn close the gripping dies. The spring has the least power at the beginning of the motion and the power increases with the motion on account of the position of the links until it ends with the dies in the closed position when the grip cannot be released. If the stock should get caught in the dies in feeding, or if an obstruction accidentally

comes between the dies, the yielding of the spring will prevent the toggles from locking or coming to their centres, which relieves the machine from unnecessary strain.

The time device regulates the length of the interval during which the dies remain closed. The movement of the connecting rod in closing the dies may be regulated by an adjustment for setting up the spring, so that the dies will remain closed for a longer or a shorter interval as desired for the work and the size of stock that is being used. This is a new feature in these machines and the adjustability of the length of closure and the relief features constitute an important improvement. Five sizes of these machines are built, viz.: 1, 1½, 2, 2½ and 3 inches.

THE SCHMIDT SUPERHEATING SYSTEM.

In nearly all steam superheating systems using temperatures above 250 degrees (482 degrees Fahrenheit) serious troubles have arisen from burned tubes, separated joints, leakage and expensive renewals, and these troubles are accompanied by wastefulness in the firebox. These difficulties may be avoided by a construction which insures perfect circulation of the fire-box gases about a large and properly arranged heating surface. The circulation of the steam in the tubes has much to do with the success of the superheater. One of the best means to avoid the burning of the tubes is to arrange them in a manner to obtain a very rapid circulation of the steam in the tubes, and a circulation relatively slow of the gases of combustion around the tubes. By these means the steam has a cooling action on the tubes, the temperature of which cannot much exceed that of the steam itself, while the gases of combustion are rapidly deprived of their great excess of heat by the tubes which are nearest to the fire-box.

An example of this was found at the local exposition at Nuremberg, where an ice machine of the Linde system, intended to make ice for a skating rink, was driven by a steam engine, using highly superheated steam, constructed by Mr. W. Schmidt & Co. at Aschersleben.

This engine was at the same time to furnish power for a portion of the electric lighting of the exposition. This service required continuous running, and this plant did not shut

raise steam with impunity to those temperatures, it behooves one to study especially both the superheater and the motor; with a steam engine of the present type, continuous running would be absolutely impossible under these conditions. In the plant with which we are now occupied, the evaporating apparatus is composed of two vertical boilers AA, with crossed boiler tubes BB, and a central chimney C. The heating sur-

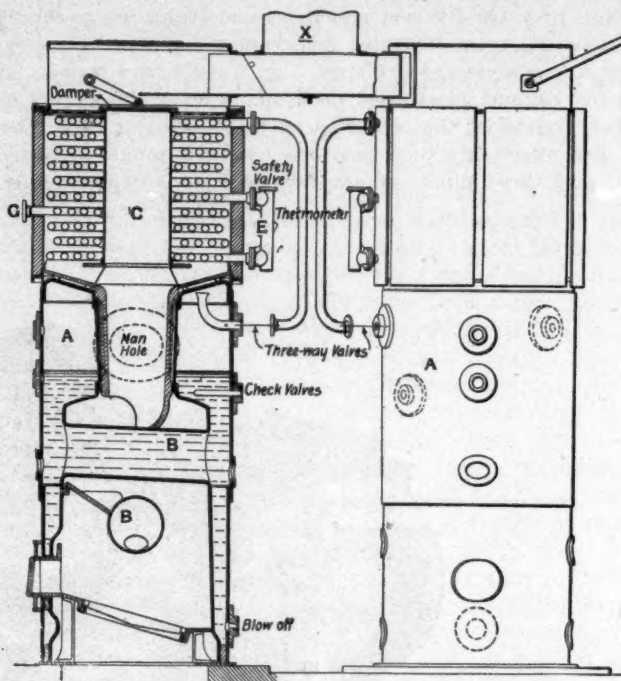


Fig. 1.—Generator and Superheater.

face of each boiler is only 7 square meters, the grate surface 0.52 meters, being for the two boilers together 14 square meters and 1.04 square meters respectively. It is to be seen that the heating surface is small in comparison to the grate surface, from which there is a very great production of steam

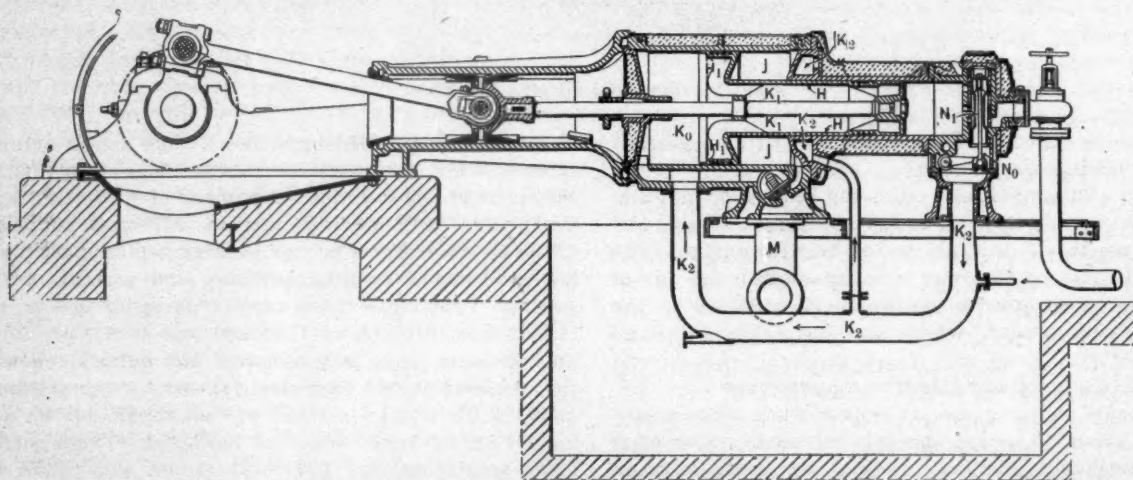


Fig. 2.—Engine for Superheated Steam.

down day or night from the opening of the exposition in June until the closing, on the first days of November. The generators and steam superheaters are shown in Fig. 1, and a diagram of the 100 H. P. motor is shown in Fig. 2.

We believe also that Mr. Schmidt was the first, and up to the present time, perhaps the only one, who has realized in practical working the employment of steam raised to temperatures neighboring 350 degrees to 380 degrees (662 and 716 Fahrenheit). It is certain that by these means a great degree of economy has been obtained, and it is also certain that to

for each square meter of heating surface. The production of steam reaches nearly 40 kilograms of steam per square meter of heating surface. It is evident that the gases of combustion must enter the chimney at a very high temperature. If these boilers were not surmounted by superheaters they would make a very poor showing.

The steam produced by such great activity is naturally very damp, but that property is utilized, on the one hand, to obtain a good utilization of the combustible with a heating surface relatively small, and on the other hand, to prevent the burning of the serpentine superheater. The superheaters are composed of a series of steel tubes rolled in flat spirals. Two rows

of spirals are made in one piece and joined to the following ones by coupling-boxes placed outside. The dismounting is thus rendered very easy. The collective heating surface of the spirals is 50 square meters. The steam after leaving the boiler enters directly into the highest of the spirals, D, and circulates rapidly in a direction contrary to that of the gases coming from the fire-box. The damp steam has a strong refrigerating action on the hot gases which escape into the chimney which is common to the two boilers. These gases, in this manner deprived of the greatest part of their heat, are still available for draft.

If this methodical circulation (in contrary directions) was maintained through the whole course, the highly superheated steam going out of the bottom of the serpentine, the steam running through the lower spirals would be very hot and absolutely dry. In this manner the last spiral which is nearest to the fire-box would be continually in danger of being burned and could not fail of being quickly deteriorated, above all under the action of a somewhat lively fire. And besides that, it would necessitate a very large heating surface to reach the desired temperature. To avoid these difficulties Mr. Schmidt changed the direction of the circulation of the steam at a determined point. After having run through six spirals from the top downward, the steam is nearly dry but not yet superheated. It then passes into a cast-iron connecting pipe, E, entering immediately into the lowest spiral, that is to say, nearest the fire-box. As the steam is then still relatively cool, it prevents the deterioration of the lower rows, and, circulating in the same direction as the hot gases, that is to say, upward, it quits the serpentine definitively at the temperature of 340 to 360 degrees (664-680 degrees Fahrenheit) to go to the motor by G.

The motor, Fig. 2, has several special features. It is a horizontal Corliss compound condensing engine. The two cylinders are tandem, acting on one common piston rod. The principal dimensions of this engine are: Small cylinder, 360 mm.; large cylinder, 750 mm.; speed, 80 turns per minute. The air pump is actuated by a pin at the crank pin and a lever. The peculiarity of this engine consists in that each cylinder is single acting, but the whole together works as a double acting engine. It will be seen that the two pistons are united in a single differential piston, HH. The small piston, H, is very long; it is a hollow plunger. The annular or ring-shaped space J, formed behind the large piston, H₂, is the low pressure cylinder. The space, K₁, in front of the two pistons, the hollow part, K₂, of the small piston and the pipes K₃, connecting the back of the small cylinder with the front of the large cylinder, form the receiver. The steam acts at first on the rear surface of the small piston, H, during the forward stroke. At the same time the steam contained in the intermediary receiver, K² K¹ K³, passes into the annular ring space, J, by the admission valve of the low pressure cylinder, L, (circular valve). There is then equilibrium, or nearly so, on the two faces of the annular piston. At the end of the forward stroke the small cylinder empties into the receiver, the low pressure cylinder, J (annular space), communicates by the circular valve, L, with the condenser, M. There is then equilibrium on the two faces of the small piston, but on the annular ring piston there is the vacuum of the condenser and the pressure of the receiver in front. In this manner the backward stroke is effected.

The aim of this peculiar arrangement of the cylinders is to avoid too great an elevation of temperature of the cylinder and of the piston receiving the superheated steam from the boiler. In fact, if the small cylinder was double acting, the walls and the piston would not be long in attaining a temperature which would render all lubrication impossible. In the actual arrangement, the period of exhaust, as well as the steam at low pressure, in the hollow part of the small piston, prevents this superelevation of temperature. At the same time the steam in the receiver and the walls of the large cylinder are reheated in a very efficacious manner. The engine is well studied from a thermometrical point of view.

In order to avoid a superelevation of the temperature of the slide-valve of admission the steam in escaping passes by the interior of this valve. In the engines of most recent construction of the Schmidt system, the distribution is made by valves, and this last precaution becomes unnecessary. Let us observe, besides, that the packing-boxes are all situated in places where there is only steam at low pressure, which assures perfect tightness. The engine is of a very solid construction and the frame rests entirely on the foundation, except as to the slide-bars.

The first trials made with this machine after an uninterrupted run of five months, of which we have spoken above, were conducted by the engineers of the "Association Bavaise de propriétaires d'appareils à vapeur." The results were remarkable. They showed a consumption of 1.41 pounds of coal per horse power per hour, and consumption of 9.9 pounds of steam per horse power per hour. These results coupled with the prolonged and uninterrupted running at Nuremberg, abundantly proves the Schmidt system of superheating to be a success and they show it to be applicable to many industries.

The fact that the different automatic couplers given in the latest Government statistics as being applied to the car equipment of the United States, number an even one hundred is noted by the "Railway Master Mechanic." This is the number for the year ending June 30, 1896. There are twenty-seven others which appear in records of previous years, but which are not set down as in use in the year named—evidently dropped out, at least for the time being. There are also records of 181 cars, having automatic couplers "unclassified." Of the 100 definitely specified 42 are on more than 100 cars each; 23 are on more than 1,000 cars each; 16 are on more than 5,000 cars each, and 9 are on more than 10,000 cars each. There are a few that go to higher figures—to the twenty and thirty thousand point—and two that go far beyond the one hundred thousand point.

The superiority of American over English mechanics was the subject of a recent letter from John Burns, the well-known labor member of the British House of Commons, to the London "Times." He testifies to the excellence of American engineering workmanship and says: "Cheap wages are not the cause. On the contrary, high wages produce that result. Neither are the hours worked a contributing factor thereto, as they are similar. It is not due either to the superiority of the American mechanic as a craftsman in the engineering trade, as they are generally of British parents or British engineers, often members of British unions, who, attracted by higher wages and similar hours, form, as I know by personal experience, the nucleus of American engineering industry. What it is due to is that the American employer has fewer deadheads to carry about, and his captains of industry are more inventive, more adaptable and assimilative, less hidebound in their methods, less prejudiced in their conceits, and more versatile in their inventive initiative."

UNITED STATES HOTEL AND THE CONVENTIONS.

It will please the friends of the United States Hotel, Saratoga, to know that the proprietors have decided to open the house in time to accommodate such of the members of the Master Car Builders' and Master Mechanics' associations and others attending the conventions in June who desire to stop there. The quiet and dignified comfort of this well-known house will be appreciated by many.

WESTINGHOUSE APPARATUS AT THE BOSTON TERMINAL.

The new Southern terminal railway station at Boston is a good illustration of the scope of the Westinghouse manufactures. The switch and signal system are provided by the Union Switch & Signal Company; the engines by the Westinghouse Machine Company; the Westinghouse Air Brake Company will equip the rolling stock and all the electrical apparatus will be supplied by the Westinghouse Electric & Manufacturing Company. The electric installation is to comprise 1,000 horse power of dynamos and motors. The station, when completed, will be the finest in the country. Electricity will be used for lighting, for driving pumps, ventilating fans, etc.

THE HOEY DRAFT ATTACHMENT.

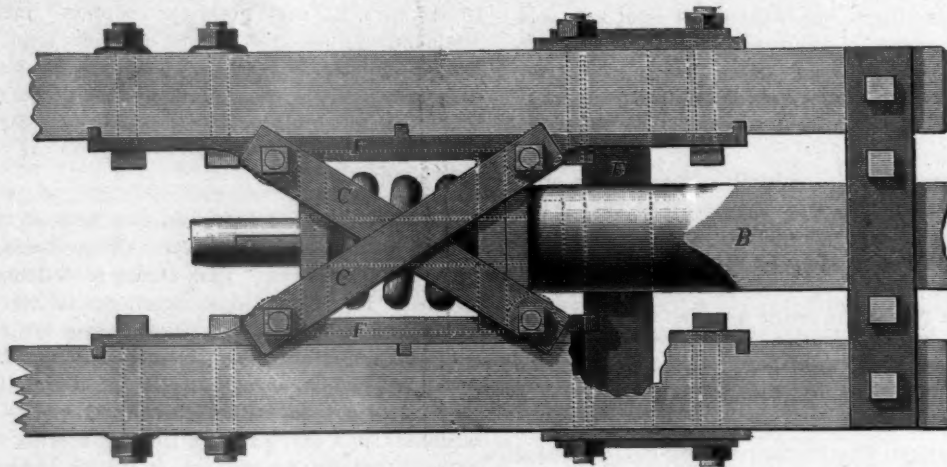
The draft attachment illustrated by the accompanying engravings was designed and patented by Mr. M. J. Hoey, foreman of Car Department of the Columbus, Hocking Valley & Toledo Railway. This device has withstood the test of time, having been in use on 4,300 cars on the road referred to, and it has been in service upon some of them for more than three years, during which time it is reported to have given entire satisfaction. Mr. Hoey recently stated, in a communication to us on the subject, that it is indorsed by the officials of the road and also by the trainmen. It is now being applied to 500 new box cars, which are under construction for this road. Mr. Hoey says:

"There are several features about this attachment which recommend it. The spring and follower pockets are made of malleable iron, and are securely fastened to the draft sills by bolts (plainly seen in the engravings), each side of the pocket being one continuous piece of malleable iron. The diagonal straps on top and bottom act as braces for the timbers, and also provide an inclosure, which prevents the follower and spring from falling out in case of a breakage. The safety key is 1 by 3 inch iron, and is independent and free from strain unless the tail pin breaks, when the strain is thrown on the safety key, and it then comes to a bearing in the slot and hauls

the latter cases. Probably the real importance of good and thorough lagging of locomotives is not appreciated. It is rather difficult to apply lagging to locomotives, except to the circular portions of the boilers, yet if it was considered necessary a way would be found to envelop the whole engine. The writer takes the ground that it is advisable to provide much better protection than is now thought necessary, and it is to be hoped that the committee appointed to report to the Master Mechanics' Association in June will speak in positive terms upon this point.

It is customary to put some kind of lagging upon the barrels of locomotive boilers; it is often of wood, which is far from being a good protection from radiation, and is a source of great annoyance and expense. Some roads are using good lagging on their boilers, but the majority do not even lag the boiler as completely as it might be done. Cylinders are also sometimes protected, but this is not yet to be considered common practice, and aside from an occasional application of lagging to the steam pipes of air brake pumps, these are all of the parts that are ordinarily protected.

As to kinds of lagging little need be said except to point out the fact that the difference between a bare surface and one that is lagged with any respectable covering is much greater than between the best and the worst of the coverings in their effect upon radiation. It may be said in passing, how-



The Hoey Draft Attachment.

the train to its destination. We have now on record 20 cases of this kind, where trains were so hauled, the length of train being 50 cars, loaded with coal, the gross tonnage being in excess of 1,700 tons. The C., H. V. & T. Ry. Co. is, without doubt, hauling as great, if not greater, tonnage per train than any other company in the country, and I claim for the attachment that the test it has been given here for the past three years should recommend it to any railway company desiring to adopt a safety device at a minimum cost."

No change in draft timbers is required for the application of this device, and tail pins may be used without fear of the couplers pulling out and falling upon the track to cause wrecks or damage to brake beams. The safety bar or key shown at E in the plan view passes through a slot in the coupler shank for the purpose of holding the coupler in place in the event of the breakage of the tail pin, as referred to by Mr. Hoey in his letter. This safeguard against the breaking of tail pins should reduce the number of break in twos. It is stated by the manufacturer, The Dayton Malleable Iron Company, Dayton, Ohio, that 18,000 of these attachments are now in use.

BOILER AND STEAM PIPE LAGGING.

During the past few years a great advance has been made in the protection of steam pipes and boilers from radiation of heat, and it may now be said that the importance of this in stationary and marine practice is generally recognized and provided for. The same progress has not been made in connection with locomotives, but it is not to be admitted that this is because such provisions are not equally desirable in

ever, that asbestos is thought by good authorities to be very much overestimated as a non-conductor of heat. Professor Ordway, in reporting upon this material as an insulating substance, said: "By reason of its fibrous character, it may be used advantageously to hold together other incombustible substances, but the less the better." In a list of 32 steam pipe coverings, Professor Ordway places four at the head of the non-combustible substances, all of which are formed with magnesia, which is clear proof of his opinion of this substance as a non-conducting covering.

The reasons why all of the surfaces of the boiler, steam chests, cylinders and the saddles of locomotives should be lagged are sufficiently apparent to need no emphasis. It is so easy to protect cylinders that this ought never to be omitted, a good method of applying the covering so that it may be removed with the outside casing, as used on the Chicago & Northwestern Railway, was illustrated in the "American Engineer" of April, 1896, page 64. A method of protecting the water legs of boilers and the back heads, as used for a number of years by Mr. Geo. W. Stevens of the Lake Shore & Michigan Southern, was fully illustrated in the report of the Master Mechanics' Association for 1885, page 106. This is no new idea, and that Mr. Stevens continues the practice after all these years is good evidence that he thinks it pays. It seems strange that no attempts, so far as the writer knows, have been made to jacket the cylinder saddle castings, and there is no doubt that a great deal of power is lost on account of the

condensation due to the exposure of these large castings as they are pushed through air at zero, or below, at sixty miles an hour. Some attempts have been made to surround the steam passages in the saddle castings with insulating material, but why should not the saddle castings themselves be lagged? Is it a question of appearance, as one Master Mechanic has suggested, or is it merely because no one has thought it necessary?

To sum up: The surfaces that might be lagged are the boiler, the sides and ends of the fire-box (as far as may be reached); the cylinders, including the heads, and the steam chests, and the cylinder and saddle castings—than which no parts carrying steam are more exposed—and the air pump pipes and feed pipes. All this may be done so that the covering may be removed and replaced. The removable covering may be applied to the fire-boxes, as in the plan shown on page 78 of the March, 1898, issue of this journal.

The first question to be decided is whether all this is necessary, which is to be ascertained only through comparative tests. The effect of the protection of all of these parts may be known by running two locomotives, in the same service, through a winter, one of them being fully protected and the other having only the usual amount of lagging. The power of the fully protected engine would probably be much greater than that of the other, because of the great loss of power that must follow the condensation of the steam in the saddle passages. If the coal records are kept with care and accuracy there should be no difficulty in ascertaining any marked advantage of the lagging.

Tests of the relative merits of various different insulating materials may be made by preparing different locomotives of the same class with the same thickness of the various coverings, by raising the same steam pressure in all of the boilers, with all of the fires in the same condition, and allowing them all to stand the same length of time in an inclosed space, where there are no air currents. The dampers and the smokestacks should be closed, and after the fires are drawn the gage pressures should be read at regular intervals. The gages should first be tested, and care should be taken to have all of the conditions alike for all of the boilers. The pressures taken every half hour and plotted on curves would give a comparison that would be valuable and instructive in showing the relative insulating powers of the various materials. It has been noted at the locomotive laboratory at Purdue University that the earlier experimental locomotive "Schenectady No. 1," with wooden lagging, when the fire was drawn at 5 p. m., would lose its pressure by midnight, whereas the new "Schenectady No. 2," which has magnesia sectional lagging, under the same conditions would hold its steam and have some pressure left in the morning. Much might be said in this connection as to the relative advantages of the two laggings when the locomotives are running through a winter storm, with the temperature at some point below zero.

Good lagging costs more than poor, yet it is not very expensive, and if it increases the power of an engine when power is most needed it is sure to be a good investment. It seems probable that we shall some time look back to the present time with wonder that the general use of an improvement so easy of application as lagging should have been so long delayed.

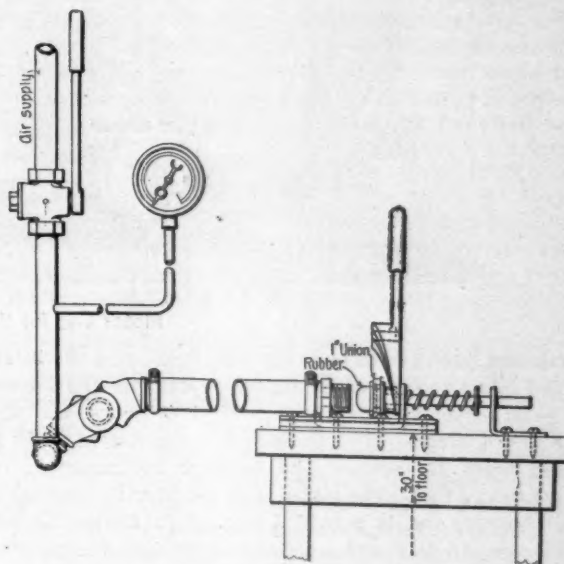
A. E.

APPARATUS FOR TESTING MOUNTED AIR HOSE.

By Oscar Antz.

While it is not a universal practice to subject air hose to a test pressure after being fitted up, it is nevertheless desirable that this should be done, and with the present practice of splicing hose which has become partly defective it is necessary to apply a test to insure having perfect work. The engraving illustrates an apparatus which has been found to answer very well for this purpose, and with it one man can test a hose thoroughly in less than half a minute.

The air pipe supplying the test pressure is provided with an ordinary cutout cock having a $\frac{3}{8}$ -inch hole drilled in the side of the chamber and plug, forming a three-way cock, by means of which air pressure can be applied to the hose and released at will. A gauge is connected to the supply pipe. Below the three-way cock is located a one-inch hose coupling having a one-inch pipe thread cut on the shank, which is screwed into an elbow and in connection with another elbow can be placed at a proper angle so that a hose coupled to it will lie in a horizontal position. The nipple of the hose to be tested is closed and made tight by means of a piece of rubber turned in a lathe to the shape shown. This is held by the nut of a union screwed on the male part of the union. To hold the hose so that this rubber can be forced against its ends, a fork shaped piece of metal is provided which fits into the space between the back of the hexagonal part of the nipples and the hose clamp, which space is usually from one-fourth to one-half inch. This fork is made of a piece



Air Hose Testing Apparatus.

of $\frac{3}{8}$ -in. sheet steel and is bent in such a shape that the base projects at the two sides, so as to slide in guides fastened to a table, to adjust its position to varying lengths of hose. On the end opposite the fork is a flange against which a wedge bears for forcing out the rubber against the hose nipple. A continuation of this flange forms a fulcrum for the operating lever of the wedge. This wedge is made circular and has a slot through the centre which keeps the union holding the rubber plug from turning. The pipe end of this union is plugged with a piece of iron into which is screwed a piece of $\frac{1}{2}$ -in. round iron to act as a guide; the back end of this part of the union is tapered at the sides to the same pitch as that of the wedge; the centre being allowed to project so as to work in the slot of the wedge. A spring on the guide rod bearing against a washer and pin brings the union back against the wedge when this is raised.

The operation of testing a hose consists in placing the coupling end into the stationary coupling, then dropping the nipple end over the fork and pressing down the lever of the wedge, which forces the rubber against the nipple, making a joint which is tight against a pressure of 100 pounds per sq. in. or less. Pressure is then applied and released by means of the three-way cock. Leaks in the hose or fittings are found by an application of soapsuds.

It is reported that the Spanish mackerel have been ordered out of American waters.

NEW CARS BY THE J. G. BRILL COMPANY.

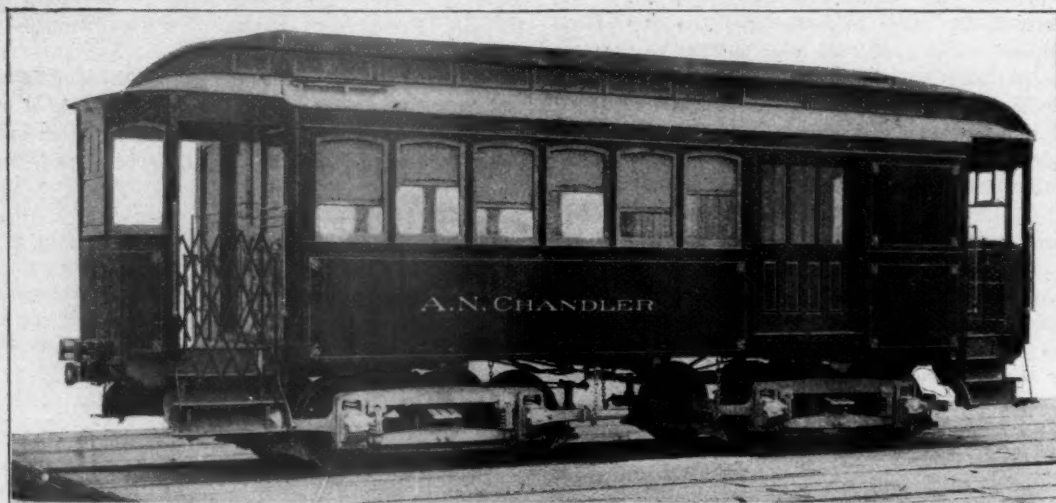
COMBINATION CAR FOR ELECTRIC ROADS.

In our March issue one of the cars by the J. G. Brill Company, now running on the Buffalo & Niagara Falls Railway, was illustrated. These cars were mounted upon Brill "Perfect" passenger trucks, and the present illustration was made from a photograph of a larger and much heavier car for high speed service on suburban lines, on the Ballston Terminal R. R. of Ballston, N. Y., using trucks of the same type. It is a combination car, having platforms and steps similar to those on

service to be maintained with a very small expense for wages. Only two men are needed to operate the car, which is intended to offer the same accommodations as local steam trains. The weight of the car, including 200 H. P. Westinghouse motors and the Christensen air brake equipment, is 60,000 pounds.

TRAILERS—N. Y., N. H. & H. R. R.

The New York, New Haven & Hartford electric motor cars have frequently been illustrated and described, but the almost equally interesting trail cars, which are hauled by the motor cars, seem to have had little attention. The accompanying

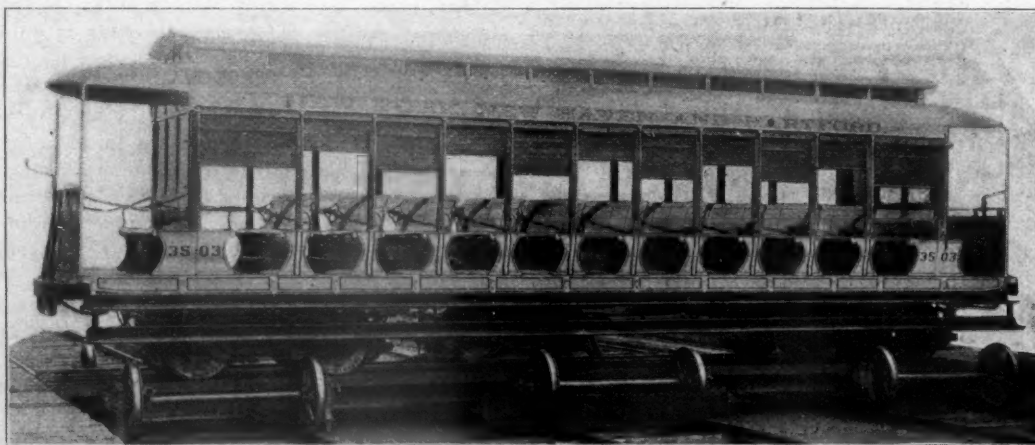


Motor Car for the Ballston Terminal R. R.

cars of steam lines. Both ends are vestibuled, and the interior is divided into two compartments for passengers and baggage.

The length over end panels is 25 feet 4 inches, the width being 8 feet 4 inches. The passenger compartment is 16 feet long and seats 22 persons, the baggage compartment is a little less than 9 feet. The latter is sheathed with tongued and grooved boards, and is provided with 4 ft. sliding doors at each side, an end door and a door to swing into the passenger compartment; this door is fitted with glass sash. The platforms are 4 feet 6 inches wide, and the roof is of the regular passenger car pattern, two trolley poles and boards are pro-

vided so that the car may run in either direction. There are two sand boxes, two gongs and gates to the vestibules. There are six windows on each side of the passenger compartment, which is fitted with cherry slat seats; drop seats are also placed in the baggage compartment for use in case of crowding, and for the accommodation of smokers. Altogether the car is as comfortable and convenient as could be desired for use on a road where high speeds are needed between stations separated by short intervals. Cars of this type enable a frequent train



Trailers for the N. Y., N. H. & H. R. R.

vided so that the car may run in either direction. There are two sand boxes, two gongs and gates to the vestibules. There are six windows on each side of the passenger compartment, which is fitted with cherry slat seats; drop seats are also placed in the baggage compartment for use in case of crowding, and for the accommodation of smokers. Altogether the car is as comfortable and convenient as could be desired for use on a road where high speeds are needed between stations separated by short intervals. Cars of this type enable a frequent train

seat panel, which in addition to the ordinary curvature is fitted to the seat with a round end so that the projecting corner, which usually interferes greatly with the lowering of the curtain, is out of the way. The curtains are of pantasote. The side steps or running board have 12 inches rise and there are two on each step. The seats are of cherry and ash slats, they are spaced 2 ft. 8 in. between centers. The platforms are closed by leather covered chains between dasher and corner posts.

BOOKS AND PAMPHLETS.

"The Calorific Value of Fuels," founded on Kestner's "Pouvoir Calorifique des Combustibles," with the addition of a very full collection of tables of heats of combustion of fuels, solid, liquid and gaseous, by Herman Poole, F. C. S., 8vo, 40 figures, 279 pp., cloth. New York, 1898, John Wiley & Sons. London, Chapman & Hall. Price, \$3.

This book was written for the purpose of collecting all of the reliable data on the subject of fuels, because the books hitherto published in English contain only a few scattered facts regarding the calorific values, and nothing comprehensive has appeared before containing information as to how the facts were obtained, and what practical use would be made of them.

As stated in the preface, the work commenced as a translation of M. Scheurer-Kestner's "Pouvoir Calorifique des Combustibles," but changes became necessary to adapt it to American methods and data, and it was deemed advisable to use the skeleton of that work, and fill it in as considered best. Even this skeleton has hardly been preserved intact, as the arrangement of much of the material has been changed, many portions omitted, many new ones supplied, and in some of the original discussions the argument has been so changed as to point nearly opposite to that advocated by M. Scheurer-Kestner. The work embraces only that portion of calorimetric determinations having a bearing on fuel values. A concise description is given of the leading calorimeters, those most commonly used being described more fully than the others, and some examples of working and calculations are added. Coal, being the fuel most generally used, is given the greatest amount of space, but other fuels are briefly considered.

The author ties theoretical and practical work together, giving information on the methods of sampling fuel and testing it. In an appendix he reproduces the report of the committee on the revision of the code for testing boilers presented to the American Society of Mechanical Engineers at the December, 1897, meeting, and also gives a set of tables of constants used in this and allied subjects and a collection of calorimetric and analytic data on all of the kinds of fuel used. These tables are of great value, they cover coals from all parts of the world as well as gas and liquid fuels. We have not seen such a complete set of fuel tables before. This feature of the book will be specially appreciated by designing engineers. Whenever possible the author gives the source and authority for his statements, which adds to the feeling of confidence with which the work will be used.

There are twelve chapters, an appendix, a table of contents and an index. The first chapter is on the general subject of fuels, heat of combustion, thermometers and calorific values. The second gives methods of determining heat of combustion. Four chapters on calorimeters follow, with description and discussion of the processes and advantages of each. These are followed by three chapters on fuels, solid, liquid and gaseous. The next three chapters apply the calorific power of coal to boilers, and in this part of the work much that is valuable in connection with boiler testing is presented.

Engineers who design and test boilers will find the book convenient and helpful. They will probably have a large part of its contents in other forms, but not so compactly arranged. The descriptive portions are concise and yet complete. The book is up to date, and, because of the lack of good presentations of calorimetric methods, it fills a place not occupied by any previous work. The fuel tables merit further mention. They contain all the available information covering the data required that have been published to date, with analyses of fuels and the heat units as determined by the authors of the tests, whose names are given. They are arranged according to a standard plan and are comparable.

The type, paper and binding are good and the illustrations in general are satisfactory. The author's care in stating authorities is to be commended, and this is specially necessary in a subject upon which some many "doctors disagree."

"The Arithmetic of the Steam Engine," by E. Sherman Gould, M. Am. Soc. C. E.; 77 pp.; cloth; New York, D. Van Nostrand Co, 1897. Price \$1.00.

This little book was written to supply the author's own need for a collection of simple and accurate facts and rules, which he had been unable to find in any single treatise on the steam engine. He does not pretend to present anything new, but does put the accepted facts of the subject into easily accessible form

for practical use. It furnishes a clear and concise summary of the fundamental principles of the steam engine and the calculations based upon them. The author states in the preface that he believes the pages contain all that is necessary to solve the ordinary problems relating to steam in its application to the steam engine. It is a good work to have at one's elbow for the purpose of "brushing up" on the simple problems of steam-using when one has become a little "rusty." It ought to be indexed, and it ought to bear its title upon its back in order to be easily found upon the shelf. We hope that our copy was an imperfect one in these respects, and that in the rest of the edition these important points were not omitted. It has not even a table of contents. Life is too short to spend time in consulting books under such conditions; they must be read through in order to find out what they contain.

"Tops, a New American Industry; a Study in the Development of the American Worsted Manufacture." Published by The Arlington Mills, Lawrence, Mass. 130 pages, illustrated; bound in buckram, 1898.

This handsome book, published by the Arlington Mills, gives an interesting and instructive account of the American worsted industry with which this concern has been identified. It describes the introduction of a new branch of industry, or a new phase of worsted manufacture into the United States. This is the manufacture of worsted "tops," which are made for the use of spinners of worsted yarn. The buildings and equipment, as well as the materials and processes, are described and the history, development and future of the industry are presented in an interesting manner. In 1891 the Arlington Mills published a history and description of its extensive plant in a book entitled "The Arlington Mills; a Historical and Descriptive Sketch," and the present volume relates to the new buildings and processes which have developed since that time. The work is a handsome production in every respect.

"The Pneumatic Despatch Tube System of the Batcheller Pneumatic Tube Company." By B. C. Batcheller, 147 7x9½-inch pages with 50 illustrations. Philadelphia, J. B. Lippincott Company.

This book gives the only complete and definite description ever published on the subject of pneumatic tubes. It is from the pen of Mr. B. C. Batcheller, Mechanical Engineer of the Batcheller Pneumatic Tube Company. The work is divided into four chapters, the first of which is a brief historical sketch, the second an explanation of the first pneumatic tubes installed by this company for the transportation of United States mail, the third describes the system and apparatus of the company and the fourth contains facts of general information relating to pneumatic tubes and the theory and practice of their working. The book describes the system thoroughly and shows the practical applications which have been made. We are glad to have a copy in our library and every well-informed engineer will probably feel the same as we do after procuring one.

"Lubricants, Oils and Greases," by Iltyd I. Redwood. 54 5½x8¼-inch pages, with three folding plates. Spon & Chamberlain. Price, \$1.50.

This is a valuable, practical book upon lubrication and lubricants. It treats the subject theoretically, and gives a great deal of information regarding the composition, uses and manufacture of lubricants, and is a good book of reference for the guidance of users of lubricants to assist in the choice of the proper article for special purposes. The author has a high opinion of grease and tells about the kinds to be avoided. Methods of testing are discussed, and his statements with regard to the manufacture of these products are valuable. The work is divided into two general divisions, "Theoretical" and "Manufacture." A number of tables and an appendix upon the action of oil on various metals are included. The style used is simple, and it is adapted to readers who are not scientifically educated.

"Practical Shop Talks." A collection of letters on shop subjects, which show by actual examples some of the existing methods of shop management and practice. By Fred H. Colvin. Press of "Locomotive Engineering," 256 Broadway, N. Y. 1898. pp. 144. Price, 50 cents.

This little volume was written in the form of letters and appeared originally as "Notes from Notown by Ichabod Podunk" in the pages of "Machinery" while that publication was edited by Mr. Colvin. They present the experience and observations of a practical mechanic in a humorous and instruct-

ive way intended specially for shop men and shop managers. It is full of sensible suggestions.

"A Method of Measuring the Pressure at Any Point on a Structure, Due to Wind Blowing Against That Structure," by Prof. Francis E. Nipher. Reprinted from the Transactions of the Academy of Science of St. Louis, Mo. Vol. III., No. 1, January 14, 1898.

This is an elaborate account of a new method of measuring wind pressures and differences of pressures by means of "collectors" in the form of metal discs with wire gauze discs between them. The experiments were carried out on a car on the Illinois Central Railroad.

"Proceedings of the South African Association of Engineers and Architects." Vol. III., 1895-6-7. Received from Eden, Fisher & Company, 6 Clement's Lane, Lombard street, London, E. C.

"Statistical Abstract of the United States, 1897." Twentieth number, containing tables of population, financial, commerce, agricultural and other leading products, mining, railroads and telegraphs, immigration, education, public lands, postal service, prices, tonnage, etc. Prepared by the Bureau of Statistics under the direction of the Secretary of the Treasury, Washington, Government Printing Office, 1898.

The John Crerar Library, Third Annual Report for the year 1897, Chicago, 1898. Clement W. Andrews, Librarian.

"Illinois Steel Company," Chicago, Ill. This is an illustrated pamphlet of 42 pages, containing a description of the various works of this large manufacturing concern.

Catalogue of Mechanical Rubber Goods manufactured by the Diamond Rubber Company, Akron, O. This company has been recently reorganized with an increase in capital stock. The new president and general manager is Mr. Walter B. Hardy, who has been connected with the Revere Rubber Company of Boston for the last ten years.

Map of Cuba.—The Sargent Company of Chicago have issued a set of maps showing the West India Islands as a group, the island of Cuba and the World, showing the relative positions of the various countries. They are printed in colors and will be sent to railroad officers and users of steel castings who may apply for them.

The Rochester Automatic Lubricator Co., Rochester, N. Y., has just issued an illustrated catalogue (not standard size) describing the "Rochester Automatic Lubricator," for locomotives, marine and stationary engines, steam pumps and hydraulic elevators. The catalogue contains a number of engravings and a large number of testimonials.

"Catalogue, 1898, Institute for Home Study of Engineering." This catalogue announces the consolidation of the "Correspondence School of Technology" of Cleveland and the "Institute for Home Study of Engineering" of the same city. The schools were started in 1894, and have been very successful, and they will now throw off the character of privacy and enter the field of public institutions. Those interested in this method of education should procure the catalogue. Address Institute for Home Study of Engineering, Blackstone Building, Cleveland, Ohio.

The recently rendered decision of the United States Supreme Court in what is known as the Nebraska Maximum Rate case is ably commented upon in the "North American Review" for April by Harry Perry Robinson, editor of the "Railway Age." Mr. Robinson contends that the attempt to reduce railway rates by legislative action would be unwise in the extreme, and he enforces his argument by reference to the statistics of the earnings of the railways of the different States.

Baldwin Locomotive Works.—Record of Recent Construction, Nos. 1, 2 and 3, March, 1898. These are 32 page pamphlets with full half tone engravings and general dimensions of locomotives recently built by this firm. One is devoted to locomotives for domestic use, and the others to those for foreign service. There is no descriptive matter, but the information pertaining to the designs is sufficiently complete to permit of making selection from the designs with reference to the ordering of locomotives.

The Anti-Scalping Law.—We received too late for publication last month the full text of the recent decision of the Appellate Division of the Supreme Court of New York declaring

the Anti-Scalping law constitutional. The decision shows great care in its preparation. It is a clear statement of the law, and it will undoubtedly be used as a reference. We are indebted to Mr. Geo. H. Daniels, General Passenger Agent of the New York Central & Hudson River Railroad, for a copy of it.

Coupler Attachments.—The Thornburgh Coupler Attachments Co., Limited, of Detroit, Mich., have issued a new catalogue, designated as No. 2, in which their box followers and the Thornburgh attachments are illustrated by half tone and line engravings. The objects of the devices are to protect the springs, reduce the number of parts, increase the strength and reduce the weights of these parts and at the same time provide easy means for replacements. The half tones show the construction of the devices admirably. The pamphlet concludes with extracts from proceedings of the Master Car Builders' Association with regard to break-in-tows with the M. C. B. coupler.

"Friction and Lubrication."—The Joseph Dixon Crucible Co. of Jersey City, N. J., have sent out an eight-page pamphlet, in which the subject of lubrication of bearings is discussed and the relative merits of oil and graphite lubrication are presented. Graphite is held to be a better lubricant, theoretically and practically, and the reasons for the conclusion are stated. The pamphlet is interesting and instructive. It was prepared especially for motive power officials, and contains a suggestion with regard to the lubrication of cylinders with graphite. Several well-known authorities are quoted to show the merits of graphite from practical experiments on friction.

EQUIPMENT AND MANUFACTURING NOTES.

LOCOMOTIVES.

The Ann Arbor has bought a switching engine from the Pittsburg Locomotive Works.

H. K. Porter & Co. will build one small locomotive for the Government. It is understood that it is for use at the Brooklyn Navy Yard.

The Canadian Locomotive & Engine Company of Kingston, Ont., is building a small tank locomotive for the British Columbia, and one compound and two simple heavy 10-wheel engines for the Intercolonial.

The Schenectady Locomotive Works will build the following locomotives: One engine for the New England Gas & Coke Company, eight for the Intercolonial Railroad of Mexico, and one for the St. Joseph Stock Yards.

The Dickson Locomotive Works will build one 10-wheel engine for the Arizona & Southeastern, two 8-wheel engines for the Green Bay & Western, and six consolidation engines for the Delaware & Hudson Canal Company.

The Richmond Locomotive Works have orders for six 10-wheel locomotives for the St. Louis Southwestern, one simple and one compound mogul engine for the Brainerd & Northern, and eight consolidation engines for the Southern Railroad.

The Brooks Locomotive Works have received orders to build two 10-wheel freight engines for the Indiana & Illinois Southern, five heavy freight engines for the Chicago, Indianapolis & Louisville, two heavy 6-wheel engines for the Union Railroad, —a branch of the Pittsburg, Bessemer & Lake Erie,—two consolidation engines for the Colorado & Northwestern, one 10-wheel freight engine for the St. Louis, Indianapolis & Eastern, five 10-wheel simple freight locomotives for the Toledo & Ohio Central.

The Baldwin Locomotive Works have received the following orders: One engine for the Sparta Iron Company, one for the Mahoning Ore Company, one for the Sorocabua & Ituana Railroad, sixteen freight locomotives for the Canada Atlantic, two for the Argentine Government Railroads, one American type locomotive for P. G. Mendez & Co. of Mexico, five mogul engines for the Egyptian Government Railways, five compound consolidation freight engines for the Ottawa Arnprior & Parry

Sound Railroad, six consolidation engines for the Roblaa Val-maseda Railroad of Spain, twelve Vauclain compound, six coupled tank locomotives, with pony trucks, for the Chinese Eastern Railroad (the Russian railroad across Manchuria), ten 10-wheel freight locomotives, four Atlantic type passenger locomotives for the Lehigh Valley, one consolidation locomotive for the Surrey, Sussex & Southampton, six two-cylinder compound freight engines for the Norfolk & Western, four consolidation engines for the Western Maryland Railroad, nine 10-wheel compound engines for the Philadelphia & Reading, one narrow gauge six-wheel mining locomotive for the Southwest Virginia Improvement Company, one shifting engine for the Standard Steel Works, one small four-wheel engine for the Ashland Coal & Coke Company, and four consolidation locomotives for the Southern Railroad.

CARS.

The Illinois Car & Equipment Co. will build 250 gondola cars for the Louisville & Nashville.

The Ensign Manufacturing Co. have orders for 200 coal cars for the Toledo & Ohio Central.

The Elliott Car Co. have received an order for 200 box cars for the New Orleans & Northeastern.

The Wason Manufacturing Co. will build four passenger cars for the Central Railroad of Brazil.

McCord journal boxes were specified for 800 cars recently ordered by the Toledo & Ohio Central.

The Union Car Co. will build 1,000 of its standard 60,000 lbs. capacity box cars for the Lehigh Valley.

The Terre Haute Car & Manufacturing Co. will build two cars for the Heatherington & Burme Railroad.

The Ohio Falls Car Mfg. Co. are building 200 freight cars and 3 postal cars for the Nashville, Chattanooga & St. Louis.

The Wells & French Co. will build 400 cars for the Toledo & Ohio Central, and three freight cars for the Fairchild & North-eastern Railroad.

The Pullman Palace Car Co. have orders to build 750 hopper bottom gondola and 250 flat bottom gondola cars for the Chesapeake & Ohio.

The Jackson & Sharp Co. are building two passenger cars for the Baltimore, Chesapeake & Atlantic, and 250 cars for the Argentine Government.

Schoen's steel truck bolsters and Bettendorf brake beams will be used on 200 stock cars to be built by the Chicago, Rock Isl- and & Pacific in its Chicago and Houston shops.

The Barney-Smith Car Co. are building the following cars: Four passenger for the Wabash Paper Co., 100 cars for the Southern Pacific, 8 new motor cars for the Metropolitan West Side Elevated of Chicago.

The St. Charles Car Co. is building one passenger car for the Kansas City, Fort Scott & Memphis, 21 cars for the Missouri Pacific, 2 passenger and 10 freight cars for the Louisiana & Northwest Railroad.

The Michigan-Peninsular Car Co. have received the following orders: 200 coal cars for the Toledo & Ohio Central, 200 refrigerator, 1,000 box and 1,000 twin hopper coal cars for the Erie Railroad.

The following roads are building cars at their own shops: The Grand Trunk 200 coal cars, the Mexican National 100 box cars, the Minneapolis & St. Louis 25 stock cars, and the Canadian Pacific 300 flat and 500 box cars.

The Missouri Car & Foundry Co. are building 4 more cars for the Wells, Fargo & Co. We referred to an order for 50 for this same company in our March issue. This firm is also building 400 box cars and 100 coal cars for the Texas Pacific, 1,500 box and 500 stock cars for the Union Pacific, 12 freight cars for the Oahu Railroad & Land Co. of Hawaii, 100 furniture cars for the Louisville & Nashville.

During the past two months the Baltimore & Ohio Railroad Company has received 1,110 new box cars, 1,239 double hopper gondolas and 224 coke cars of the orders for 5,150 cars recently placed with Pullman's Palace Car Company, the Michigan Peninsular Car Works, the Missouri Car and Foundry Company and the South Baltimore Car Works. Deliveries are being made as rapidly as the cars are completed.

The Schoen Pressed Steel Co. have an order for 1,000 steel cars of 110,000 lbs. capacity for the Pennsylvania Railroad. The contract is about \$1,000,000, and is the largest contract ever given for steel cars, and it points to the probability that steel cars will come into use very rapidly, owing to the endorsement by this road. These cars will be 10 feet high from the top of the rail, and will carry 110,000 lbs. of ore and 104,000 lbs. of coal. They will weigh 37,000 lbs. each and will have 5½ by 10 inch journals. The same builders are at work on an order for 200 more cars of the same size for the Pennsylvania west of Pittsburg. The order is to be completed by Oct. 1.

MISCELLANEOUS.

The Western agency of the Pennsylvania Steel Co. has been taken by the Q & C Co., Western Union Building, Chicago.

The new underground railway of London has decided to use the Westinghouse Air Brake.

The plant of the Schoen Pressed Steel Co. is to be enlarged to such an extent as to increase the present capacity of 20 cars per day up to 50 per day.

Six Patton combination gasoline and electric motor cars are now building at the Siemens & Halske Works in Chicago. They are to be used in suburban service at Chattanooga, Tenn.

An Australian rail contract amounting to 14,030 tons has been taken by the Pennsylvania Steel Company in competition with two English, one German and one other American firm. The price of the accepted bid was \$19,000 less than the English bids.

The Edward P. Allis Company of Milwaukee, Wis., has delivered to the Carnegie Steel Company, Ltd., at Pittsburg, for their Duquesne Steel Works, a large Bessemer blowing engine. The shipping weight of this engine will be about 500,000 pounds.

Work on government contracts has led to a number of good orders for hydraulic machinery placed with Messrs. Watson & Stillman, including several large forging presses for the navy department, and powder presses for the manufacture of smokeless powder.

The electric lines of the New York, New Haven & Hartford are to be extended and the rail between East Weymouth and Braintree are now being changed from 56 pound to 100 pound section. This addition will bring the total line operated by electricity to 15 miles in length. The electric trains at Braintree are to be turned on a loop in order to facilitate traffic.

The Westinghouse Electric and Manufacturing Company has just opened a new branch office at Austin, Tex. Mr. J. E. Johnson will have charge of the office and of the further extension of Westinghouse business in the Southwest. The large contracts which this company has been handling in Mexico and the Texas region have led to the establishment of this new center of electrical trade.

The electric railways projected in Japan are three in number. Consul Lyon, writing from Kobe, says that one is to be 15 miles in length, extending from Kobe to Amagasaki. The company has a capital of \$249,000, and the work is to be completed within two years. The time for beginning the work is not fixed. Another line is to be between Amagasaki and Osaka—5 miles. The company is to have a capital of \$149,900. The charter has not yet been granted. The promoters of these two roads are Mr. Shinyemon Konishi, of Itamicho, Kawabe-gun, Japan; Mr. Ki-ichiro Kosone, of Minato-cho, Kobe-shi, Japan, and twenty-eight others. Another road is projected to run from Kobe to Arima, 15 miles. The capital is \$149,000. The date for commencing the work is not fixed. The promoters are Mr. Ki-ichiro

Naka, of Arino-mura, Arima-gun, Japan; Mr. Shigezo Yamamoto, of Fukiai-mura, Kobe-shi, Japan, and eighteen others.

Japan apparently favors American iron and steel. The New York Commercial prints an interview with Mr. L. C. Brittain, of London, touching this, in which he said: "For example, during my recent sojourn in Tokio I happened to hear of an opportunity to place a large order of iron and steel products. I am interested in the iron business, and I decided to make a bid. Imagine my surprise when I was politely informed that it would be impossible to consider any other offers than those made by American firms. I asked the reason for this, and was told that in the opinion of experts of Japan, the United States furnished the best article to be found in the markets of the world. I intend to make it my business when I return home to have at least one iron and steel company in Great Britain properly represented in the leading cities of Japan and China. If need be, we will hire Americans to do the work, for apparently they are the best for drumming up trade."

The rapid movement of the Government Reindeer Special over the Pennsylvania, the Chicago, Milwaukee & St. Paul and the Great Northern Railroads was noted last month. Mr. G. D. Meiklejohn, Assistant Secretary of War, wrote the following letter to Mr. J. B. Thayer, Jr., General Freight Agent of the Pennsylvania, dated Washington, D. C., March 15, 1898: "I take this opportunity to thank you on behalf of the War Department for the very prompt, efficient and entirely satisfactory service rendered by your road, in connection with the Chicago, Milwaukee and St. Paul and Great Northern Railways, in transporting the Government reindeer expedition and attendants across the continent. The arrangements, so complete in every detail, provided for the safety and comfort of the expedition, enabled the trip to be made without inconvenience, sickness, or serious mishap of any kind, and the entire expedition arrived at the western terminus in the best of condition. The time made by your road surpassed all expectations, and the success of the shipment was very gratifying to the Department."

Our Directory

OF OFFICIAL CHANGES IN APRIL.

Atlantic and North Carolina.—Mr. David W. Patrick has been appointed President, succeeding Mr. Robert Hancock.

Atchison, Topeka & Santa Fe Pacific.—Mr. George W. Smith, heretofore Master Mechanic of the Eastern Division of the A. T. & S. F., with headquarters in Topeka, Kan., has been appointed Superintendent of Machinery, with headquarters at Albuquerque, N. M.

Canada Atlantic.—Mr. M. Donaldson has been appointed General Superintendent; he was formerly Superintendent.

Canadian Pacific.—Mr. J. W. Harkom has been appointed Assistant Mechanical Superintendent; he was formerly Master Mechanic of the Eastern Division of the Grand Trunk.

Central of New Jersey.—Mr. W. L. Hoffecker has been appointed Master Mechanic in charge of New Jersey Central division. Mr. J. G. Thomas is appointed division Master Mechanic in charge of Lehigh & Susquehanna Division. Mr. J. H. Thompson has been appointed Chief Engineer, with headquarters at Jersey City, N. J., and the office of Engineer of Construction, formerly held by him, has been abolished.

Central Pacific.—Mr. William Thompson of San Francisco, has been elected a Director, succeeding Mr. I. E. Gates of New York, and Mr. William H. Mills, heretofore Second Vice-President and Treasurer, was elected Vice-President and Treasurer. Mr. J. C. Kirkpatrick was elected Second Vice-President and Mr. Charles P. Eels was elected Third Vice-President.

Chicago Great Western.—Mr. Raymond Du Puy has been appointed General Superintendent, with headquarters at St. Paul, Minn., to succeed Mr. Cornelius Shields, resigned.

Chicago & Northwestern.—Mr. Frank Slater has been appointed Master Mechanic, with office at Escanaba, Mich., vice Mr. J. W. Clark, resigned.

Chicago, Milwaukee & St. Paul.—Mr. H. R. Williams has been appointed General Superintendent, with headquarters at Chicago, succeeding Mr. W. G. Collins, promoted to the position of General Manager and relieving Mr. A. J. Earling of the duties of that office.

Chicago & South Eastern.—Mr. W. C. Halfman has been appointed Master Mechanic, with headquarters at Lebanon, Ind., to succeed Mr. J. W. Roberts.

Chicago, Rock Island & Pacific.—Mr. J. Van Dell has been appointed Master Car Builder, in charge of the Chicago shops, to succeed Mr. L. T. Canfield, resigned.

Cleveland, Cincinnati, Chicago & St. Louis.—Mr. George

Tozzer has been appointed Purchasing Agent; he was formerly Assistant Purchasing Agent, with office at Cincinnati, succeeding the late Mr. A. M. Stimson.

Detroit, Toledo & Milwaukee.—Mr. J. R. Megrue has resigned as Vice-President and General Manager, and Mr. N. K. Elliot will have charge of the operation and maintenance of the property with the title of Superintendent. Mr. J. W. Witmer has resigned as Master Mechanic, and Mr. L. M. Studevant has been appointed Purchasing Agent.

Detroit & Lima Northern.—Mr. J. W. Witmer, Master Mechanic of this road, formerly at Marshall, Mich., will hereafter make his headquarters at Tecumseh, Mich.

Delaware, Lackawanna & Western.—Mr. W. F. Hallstead is now Second Vice-President as well as General Manager.

Florida East Coast.—Mr. R. W. Parsons has been appointed Second Vice-President, with headquarters at 26 Broadway, New York.

Galveston, Houston & Henderson.—Mr. Leroy Trice has been elected Vice-President, succeeding Mr. John M. Duncan.

Gulf, Beaumont & Kansas City.—Mr. J. F. Weed has been appointed Chief Engineer, with headquarters at Beaumont, Tex.

Grand Trunk.—Mr. J. W. Harkom has resigned as Master Mechanic of the Eastern Division, with office at Montreal, and has been succeeded by Mr. Thomas McHattie as Acting Master Mechanic.

International & Great Northern.—Mr. Leroy Trice, the General Superintendent of this road, has also been elected a Director.

Knoxville & Bristol.—Mr. J. V. Woodward of Philadelphia has been elected President, succeeding Mr. Adolph Segal.

Lake Erie & Detroit River.—Mr. Joseph De Gurse, Chief Engineer, died at Winsor, Ont., March 22, at the age of 41 years.

Lake Shore & Michigan Southern.—Mr. W. H. Newman, Second Vice-President of the Great Northern, has been selected to succeed Mr. S. R. Callaway as President.

Missouri, Kansas & Texas.—Mr. Colgate Hoyt has been elected Vice-President, succeeding Mr. William Dowd.

Mobile & Birmingham.—Mr. J. J. Thomas, heretofore Master Mechanic, with office at Mobile, Ala., has resigned to go to the Mobile & Ohio.

Morgan's Louisiana & Texas.—Mr. J. G. Schriever, Vice-President, died at New York recently, at the age of 54.

New York Central & Hudson River.—Mr. Chauncey M. Depew has resigned as President, to take the Chairmanship of the Board of Directors of the Vanderbilt lines. He has been succeeded by Mr. L. R. Callaway, formerly President of the Lake Shore. Mr. H. Walter Webb has resigned as Third Vice-President.

New York, Chicago & St. Louis.—Mr. Theo. H. Curtis, formerly Chief Draftsman, has been given the title of Mechanical Engineer.

Oregon Short Line.—Mr. D. J. Malone has been appointed Master Mechanic of the Idaho and Montana Divisions, with headquarters at Pocatello. Mr. W. J. Tollerton has been appointed Master Mechanic of the Utah Division, with headquarters at Salt Lake City, Utah.

Pennsylvania.—Mr. W. F. Beardsley, Master Mechanic of the shops of the Pennsylvania lines at Allegheny, Pa., has had his jurisdiction extended over the Erie & Ashtabula Division, effective April 1, and Mr. T. A. Kircher has been appointed Assistant Master Mechanic at the Allegheny shops.

Plant System.—Mr. J. G. Justice, formerly General Foreman at Waycross, Ga., has been appointed Master Mechanic at Savannah, Ga., succeeding Mr. D. B. Overton, resigned. Mr. S. M. Roberts has been appointed General Foreman at Waycross, succeeding Mr. Justice.

Rockport, Langdon & Northern.—Mr. John P. Lewis has been elected President, succeeding Mr. John Lockwood. His office will be at Rockport, Me.

Salt Lake & Ogden.—Mr. James M. Kirk has been appointed Master Mechanic, with headquarters at Salt Lake City, Utah, to succeed Mr. W. T. Godfrey, resigned.

Sherman, Shreveport & Southern.—Mr. W. A. Williams has been elected Vice-President, succeeding Mr. Thomas H. King.

Southern Pacific.—Mr. J. Kruttschnitt has been elected Fourth Vice-President; he is also General Manager.

St. Louis & San Francisco.—Mr. C. H. Beggs has been appointed Purchasing Agent, he is also Secretary to Vice-President and General Manager, with office at St. Louis.

St. Louis & Kansas City.—Mr. J. W. Sherwood has been appointed General Superintendent, with headquarters at Toledo, Ohio, vice Mr. A. L. Mills, resigned.

Terre Haute & Indianapolis.—Mr. George W. Prescott, formerly Superintendent of Motive Power, has been appointed Foreman of the shops of that road at Logansport, Ind., to take effect April 1.

Texas Central.—Mr. Charles Hamilton has been elected Vice-President and General Manager, with office at Waco, Tex., and Mr. Richard Oliver has been elected Secretary and Treasurer.

Washington & Columbia River.—The positions of Assistant General Manager and Superintendent of Motive Power, which were held by Mr. F. Rogers and Mr. J. M. Winslow, have been abolished.

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BALDWIN TWO CYLINDER COMPOUND LOCOMOTIVES— NORFOLK AND WESTERN RAILWAY. With an Inset.

The Baldwin Locomotive Works recently built six heavy, two cylinder compound consolidation locomotives for the Norfolk and Western Railway, from designs worked up conjointly by the builders and the railway company. These engines have a number of new features, which are interesting to students in locomotive design. They are known as "Class B." The most interesting feature of the design is the compounding arrangement, which can be easily understood by reference to the drawings showing the details of the cylinders, and the operation of the intercepting and reducing valves. The dimensions of the engine are shown in Fig. 2. To us this appears to be the handsomest heavy engine that we have seen.

Steam is admitted from the throttle directly to the high-pressure steam chest, passing through the saddle of the high-pressure cylinder and around the intercepting valve, which, with the reducing valve, is located in the saddle of the high-pressure cylinder; these cylinders being also provided with an independent exhaust pipe as in simple engines. The low-pressure cylinder is substantially like an ordinary simple engine, except that it receives its steam from an intermediate receiver, located in the smoke box instead of from the T head, and it also has an independent exhaust pipe. One general distinction between this two-cylinder compound and those in general use, consists in the fact that the operation of the engine as a single expansion or compound locomotive is not governed automatically, but is entirely under the control of the engineman, so that it can be operated either way as desired by simply turning the handle of a valve in the cab. When the cab valve is in the position for simple working, upon the opening of the throttle the valves assume the position shown in Fig. 3. Under these circumstances, steam from the exhaust of the high-pressure cylinder passes through the intercepting valve and directly to the high-pressure exhaust pipe, precisely as in a simple engine. Steam also passes through the opening of the reducing valve into the intermediate receiver, and lifts the reducing equalizing valve, establishing communication between the receiver and the large end of the reducing valve. The reducing check valve is kept shut by the receiver pressure being upon it. The two ends of the reducing valve have proportions the same as the high and low pressure cylinders, and as the steam passes from the

receiver into the low-pressure cylinder, the reduced receiver pressure controls the reducing valve, closing it or opening it to allow the proper wire drawing of high-pressure steam to fill the receiver, which pressure is supposed to be about 85 pounds, the safety valve on the receiver, immediately ahead of the smoke stack, being set to 90 pounds. Under these conditions the engine will run as a simple engine, reducing the steam from the boiler to suit the increased size of the low-pressure cylinder, the cab valve being maintained in the position marked simple.

When desiring to compound the engine, the cab valve is turned to the compound position. This admits steam from the boiler into the pipe running to the intercepting valve, pushing it ahead, thus cutting off the opening to the exhaust pipe, and compelling steam from the high-pressure exhaust port to pass into the receiver. At the same time steam passes to the reducing valve, closing the reducing equalizer valve by means of the packing rings and pressure on top of the valve, and opens the reducing check valve, thus admitting full steam pressure on the large portion of the reducing valve, which by this excess pressure is closed, thereby preventing the ad-

DATA ACCOMPANYING INDICATOR CARDS.

Card number.	Per cent. grade.	Speed.	Throttle opening.	Reverse lever.	Simple or compound.	Boiler pressure.	Steam line H. P. cylinder.	M. E. P.		Indicated tractive power.		Per cent. of work in H. P. cylinder.
								H. P. cylinder.	L. P. cylinder.	H. P. cylinder.	L. P. cylinder.	
1	1.2	14	1	1	Comp.	195	189.0	126.5	52.0	19,100	18,200	37,300
2	2.2	7	1	1	"	185	177.0	107.4	44.5	16,300	19,100	35,400
3	2.2	7.5	1	1	"	187	185.0	111.0	56.0	16,800	19,300	37,900
4	2.2	8.5	1	1	"	185	182.0	103.0	62.5	15,600	21,900	37,500
5	2.2	7.5	1	1	"	194	192.5	122.0	59.0	20,458	20,650	41,108
6	2.2	8.5	1	1	"	187	186.5	112.5	46.0	18,665	16,007	34,572
7	2.2	6.0	1	1	"	190	186.5	115.0	57.2	19,285	20,025	39,310
8	2.3	7	1	1	"	190	186.0	108.5	52.3	16,400	18,300	34,700
9	2.0	9	1	1	"	187	183.0	109.5	49.5	16,600	17,400	34,000
10	2.0	9.5	1	1	"	185	186.5	118.5	55.7	19,870	19,500	39,370
11	2.0	10.5	1	1	"	190	188.0	109.0	53.5	16,500	18,700	35,200
12	2.0	11.5	1	1	"	200	138.0	74.5	33.7	11,300	11,800	23,100
13	1.2	10	1	1	"	195	192.0	110.8	41.0	16,800	14,400	31,200
14	2.0	11	1	1	"	192	190.0	98.5	53.8	14,900	18,900	33,800
15	2.0	9	1	1	"	192	190.0	115.0	50.0	17,400	17,500	34,900
16	1.2	11	1	1	"	190	108.0	51.8	14.3	7,850	6,750	14,600
17	1.2	11.5	1	1	"	200	190.0	109.6	36.6	16,600	12,800	29,400
18	1.2	8.5	1	1	"	205	184.5	98.7	47.3	16,565	16,550	33,115
19	1.2	8	1	1	"	192	186.0	86.4	44.5	13,100	15,600	28,700
20	1.2	13.5	1	1	"	200	100.0	38.5	14.5	5,800	6,830	12,630
21	1.2	15	1	1	"	184	150.0	62.5	22.5	9,450	7,900	17,350
22	1.2	16	1	1	"	185	88.0	32.0	12.5	4,800	4,380	9,180
23	1.2	9.5	1	1	"	195	187.5	90.5	45.25	15,180	15,835	31,015
24	1.2	13	1	1	"	200	190.0	77.9	31.7	11,800	11,100	22,900
25	1.2	13.5	1	1	"	198	185.0	76.3	30.8	11,500	10,800	22,300
26	1	13.5	1	1	"	200	192.5	80.2	31.8	13,460	11,160	24,620
27	2.0	5.8	1	1	Sim.	184	78.0	70.1	36.4	10,600	12,800	23,400
28	2.0	5.8	1	1	"	200	146.0	131.5	60.0	19,900	20,700	40,600
29	2.0	7.3	1	1	"	200	138.0	122.5	50.0	18,500	17,500	36,000
30	2.3	5.0	1	1	"	198	44.0	35.7	13.9	5,400	4,870	10,270
31	2.2	4.0	1	1	"	180	110.0	98.9	45.5	14,900	15,900	30,800
32	2.3	5.8	1	1	"	200	95.0	83.8	35.8	12,700	12,500	25,200
33	2.0	11	1	1	"	200	188.0	101.0	41.7	16,942	14,780	31,722
34	2.0	7.0	1	1	"	180	120.0	99.5	43.5	15,100	15,200	30,300
35	1.2	12.0	1	1	"	185	140.0	109.0	34.3	16,500	12,000	28,500
36	1.2	10	1	1	"	195	135.0	100.0	32.9	15,100	11,500	26,600

mission of steam direct to the intermediate receiver, the reducing equalized valve, in this case, shutting off the connection between the large portion of reducing valve and the intermediate receiver.

When, for any purpose, it is desired to change the engine back to simple, the cab valve is turned to that position, thus exhausting the steam out of the pipe to the cylinder, whence the intercepting valve will return to its first position, being impelled by the spring and also the receiver pressure acting against the piston on the front end. The exhausting of the steam from the small pipe, by means of the cab valve, is followed by the closing of the reducing check valve, and by the opening of the reducing equalizer valve by the excess pressure on the under side, thus establishing communication with the receiver, and allowing the reducing valve to open, admitting the proper supply of steam from the direct steam passage in the high pressure cylinder saddle.

If a particularly difficult portion of track requires simple